ELECTRICAL REVIEW

[ILLUSTRATED.]

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ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

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A Large Battery of Storage Cells.

The largest battery of accumulators now at work in France, says *Industries*, is that at the Hotel de Ville in Paris. It was installed on the recommendation of the late M. Bartet, of the Public Works Department, and according to the original intention it was to have sufficient capacity to keep the 2,200 Edison lamps in the Hotel de Ville alight during a whole night; but as actually installed it only acts as a regulating battery, and in case of accident to the machinery, would only suffice to keep the lamps going for an hour or two. This battery is remarkable for the fact that the old form of Planté cells with spiral plates has been chosen. The active surface of each plate is about 52 square feet, and the storage capacity has been increased on Planté's principle by pickling in nitric acid. Each cell is capable of giving a current of 240 amperes, which, at the average pressure of 1.9 volts, represents a discharge at the rate of .6 horse power. Since there are 165 cells the total energy is about 100 horse power. These batteries were made by Reynier, and have a total weight of 11 tons. Current is supplied by three Gramme dynamos driven from portable engines in an annexed building, and since the speed of the engine is not very regular, the employment of these batteries as a steadying device has been found almost absolutely necessary.

Cooking by Electricity.

[From Richmond (Va.) *Dispatch*.]

The New York ELECTRICAL REVIEW of September 10th, referring to the preparation of the building to be occupied by the New York Electric Club, composed of 300 members, says:

"Everything that can be done by electricity will be done, but as yet the cooking will be done in the usual way. If Dr. W. Leigh Burton will hurry up his cooking apparatus the club will be glad to use it."

Referring to the above, the *Dispatch* is authorized by Dr. Burton to say that the honor of cooking by electricity belongs to Richmond, as over five years ago he cooked beefsteak and boiled eggs on one of his electric heaters. He promises, however, that the great city of New York shall have the next opportunity in this line, and before another year rolls around the members of the Electric Club will be eating fried oysters and drinking coffee prepared by electric heat.

Fishing by the Electric Light.

Some interesting experiments in connection with the subject of fishing, the *Scotsman* states, have been carried on in the Firth of Forth, under the patent system of Captain Coppin. It has long been understood that fish are strongly attracted towards any bright light—a fact utilized by the salmon night-fisher, who uses a flaming pine-torch to bring the prey within reach of his "leister" or spear; and it is proposed under this system to employ by way of lure the powerful light of the electric lamp. A number of gentlemen having obtained the use of the steamship Tweeddale, kindly granted by Mr. Scott, of the General Steam Fishing Company, Granton have had her completely fitted out for the purpose with electric apparatus, engine, and dynamo, arc lamps of 6 000 candle power, incandescent submarine lamps, etc. The work has been done under the superintendence of Mr. Greville E. Johnston, on behalf of Messrs. T. H. Perry & Co., Electrical Engineers, Liverpool. Recently the vessel, thus equipped was engaged in her novel fishing cruise in the neighborhood of the Isle of May. The experiments, however, have not, so far, been successful. The electric lamps were sunk with the beam of the net to a depth of 40 or 50 fathoms, the glass globe being about $\frac{3}{8}$ of an inch thick. Operations were carried on for about an hour on two occasions, and it was found that the pressure of the water was too great for the strength of the glass, the result being that the lamps broke, and the light instantly went out. It is intended to renew the experiments, using stronger glass.

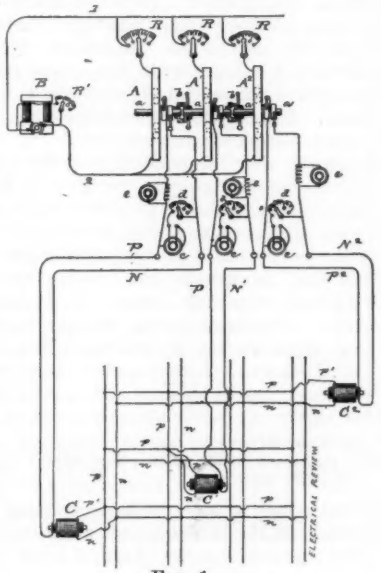

FIG. 1.

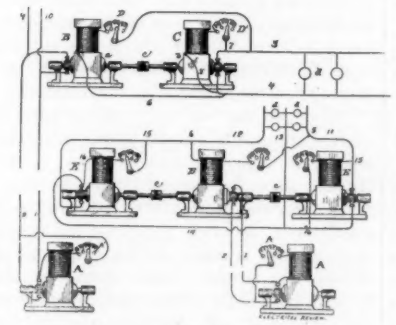

FIG. 2.

FIG. 4.

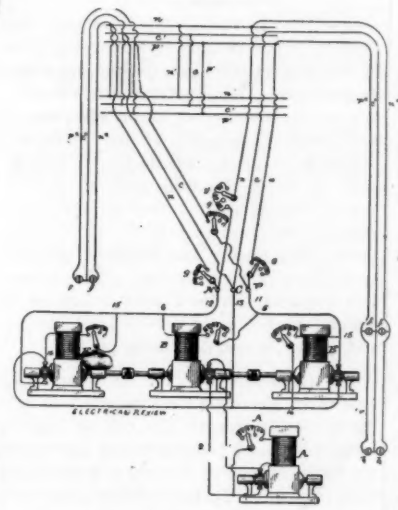

FIG. 3.

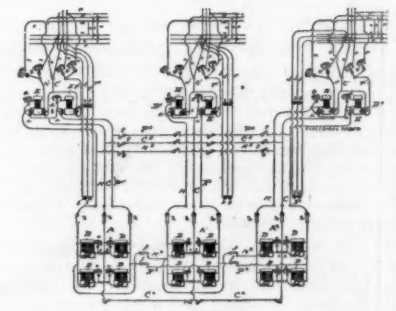

FIG. 5.

LONG DISTANCE ELECTRIC DISTRIBUTION, AS SHOWN IN RECENT PATENTS ISSUED TO THOMAS A. EDISON.

* * * The Ball Engine Company, of Erie, Pa., are running night and day in order to meet the increasing demands for their engines. During the first half of the year 1887 they have turned out in the neighborhood of 15,000 horse power, almost an engine daily, which attests to the popularity of these engines.

Long-Distance Distribution.

As this subject is one of great importance to the electric-lighting fraternity, and just now is of absorbing interest, we give our readers this week a synopsis of the latest patents issued in the field of transformation by induction, that they may see how the march of improvement goes steadily onward. Mr. Edison is the only patentee in the issue of September 6, 1887, on this subject. He has four patents, all on systems of electrical distribution.

No. 369,439, filed December 6, 1886 (see Fig. 1), covers a novel arrangement of the generators at the source of supply, whereby current of equal and constant potential is given to all parts of the district supplied, and the indication and regulation of such current for the purpose of maintaining such constant and equal potentials is readily and conveniently performed. He employs as a source of supply two or more alternating-current dynamo-electric machines having their armatures all mounted upon the same shaft or all mechanically connected together, and arranged to be regulated either independently or simultaneously. From each of these generators a circuit extends to the district supplied, where preferably is a system of intersecting and connected positive and negative main or lighting conductors, with which the electric lamps, electric motors, or other translating devices are connected, the connection between the circuits from the source and said main or lighting circuits being through converters or tension-reducing devices, which, since alternating generators are employed, may be simple induction coils, and which convert the generated current of high tension to currents of low tension adapted for use in the translating devices. Each generator circuit is provided with suitable indicating devices, *c* and *c*, in order to show pressure and current.

A A^1 A^2 are alternate current high tension machines with armatures mechanically clutched together, the field magnets charged by a continuous current exciter *B*. Resistances *R R* serve to regulate the pressure on any or all mains. In each distributing circuit is a tension reducing converter *C* C^1 C^2, whose secondary or low tension circuits *p' n'* are connected with the system of lighting conductors, usually at centers of consumption at or near which the converters are placed.

The same constant potential is maintained on all the circuits, as changes occur in the number of translating devices in circuit in the different parts of the district, while to vary the entire current supplied the resistance *R'* in the field circuit of continuous current generator *B* is adjusted, whereby the field magnet strength of all the alternating machines is varied simultaneously.

For greater changes in the whole current supplied, one or more machines may be connected or disconnected from the driving power by means of the clutches *b*.

No. 369,441, FILED DEC. 16, 1886.

This patent covers an arrangement which is not exactly "transformation" in its ordinary sense. The working current is produced by using the high tension current from the central station to drive a motor,

which is coupled to a low tension dynamo to directly generate the lighting current, the object being to provide a simple and efficient system which may be readily and conveniently regulated, and which shall employ *continuous* currents, thereby doing away with the danger to life which arises when high tension *alternating* currents are used.

The invention may be employed either with a two-wire or multiple arc system or with the three-wire or compensating multiple series system.

An inspection of the diagrams so clearly discloses the main ideas involved that description is unnecessary. Fig. 2 in its upper portion shows the principle applied to a simple multiple arc system; and in its lower portion the application to a multiple series system. Fig. 3 is a diagram of the complete connections and arrangements for a three-wire distributing system.

The claims of this patent are 16 in number, and seem to spread over about the whole field of indirect or double conversion.

No. 369,442, Filed Dec. 22, 1886—System of Electrical Distribution.

The object of the invention is to regulate at the sub-station the electromotive force on the high tension line, a constant electromotive force being maintained at the main station. He places in the high tension circuit at the sub-station a suitable current-varying device, the regulation or adjustment of which varies the condition of the high-tension circuit.

Fig. 4 is a diagram of a three-wire system embodying the principle.

A A represent dynamo-electric machines generating currents of high tension, situated at the main station. They are arranged to form the divided source of electricity of a three-wire or compensating system. From the generators a three-wire circuit extends, conveying the high-tension current to the sub-station, which is situated within or near the district to be supplied with current.

At the sub-station are placed double wound rotating converters *B B*, which receive the high tension current at one commutator and discharge at another current of the desired comparatively low tension. The two converters are placed in series as a divided source, and the three-wire low tension circuit 4, 6, 5, extends from such source, supplying translating devices *a a* in multiple series.

In each side of the high tension line at the sub station is connected an electro-dynamic motor, *C*. These motors are so wound that at a normal speed—say at one-half their full speed—they throw a low or minimum counter electromotive force into the high tension circuit. The fields of these motors may be energized in any suitable manner. As shown, they are energized from the high tension circuit.

D D are motors run from the low tension circuit, and having adjustable resistances *E E* in their field circuits, whereby their speed is regulated. Each of these motors has its armature shaft connected, either directly, as shown, or through suitable belts or gearing, with the armature shaft of one of the motors *C C*.

The operation is as follows: Suppose the main source to have a constant pressure of two thousand five hundred volts and the motors *C* to give each a back pressure of five hundred volts. The effective pressure will then be two thousand volts; but if an increased load on the converters causes a decrease in this pressure and it is desired to bring the pressure up again, the fields of the motors *D* are strengthened by throwing out more resistance, and the speed of such motors, and consequently of motors *C*, is decreased, whereby the counter electromotive force of motors *C* is reduced and the pressure on the high tension circuit is brought up to the desired two thousand volts again. If the load on the converters decreases so that the pressure must be reduced to bring it to the constant, the fields of motors *D* are weakened and the counter electromotive force of motors *C* is reduced again.

Either side of the three-wire circuit may be regulated separately, as will be readily seen, as the relative number of translating devices on the two sides varies. The invention may be as readily used with a two wire system of distribution.

No. 369,443. Filed Dec. 27, 1886. System of Electrical Distribution.

Relates to arrangements and details for combining and regulating two or more systems of direct transformation from high to low tension, so that one source may be made to supply two or more distributing systems, or two or more sources may be thrown onto one distributing system, as such changes are made desirable by reason of variations in the current required by the districts.

Fig. 5 is a diagram of the arrangements. The generators *B* are continuous-current generators, and he therefore provides double-wound rotating tension-reducing converters, *E E*, at each sub-station.

Normally each of the three systems is run by itself, and is regulated by the adjustment of the field-magnets of generators *B* for the general regulation of the district, and by the feeder resistances for the changes in distribution and balance; but when so many translating devices are disconnected in the several, or in any one or more of the districts, that it becomes unnecessary to run so many dynamos to supply those remaining, all three of the districts may be thrown upon the generators of one group. In some cases it may be desired to do this at the sub-station. In this case it is done by closing the proper set of switches, *g*, in the conductors P^3 N^3 C^3, so that all three of the districts are thrown upon either one of the generator groups, or upon any two of them; or two districts may be thrown upon a single group, and the third district still run separately from its own group; or such combinations may be made as the exigencies of the case may require. These operations may be performed at the main station, if desired, the circuits P^3 C^3 N^3 being provided for this purpose.

—— The Lawrence Gas Company has decided to put in a complete steam plant for running electric lights in connection with its gas lights. After a thorough examination of the steam plant of the Charlestown Gas Company, installed by the Jarvis Engineering Company, of Boston, it has decided to adopt the same system, and has ordered two Armington & Sims Company's engines, and two boilers to be set with the Jarvis boiler setting and Sheffield grates to burn coke screenings for fuel. The contract also includes National feed water heater pump, injector, piping, iron smoke stack and, in fact, a complete steam plant.

—— Rochester, N. Y., has contracted with three electric light companies to light the city for five years. The cost of lighting the city for a series of years past has been in the neighborhood of $90,000 to $100,000 annually. Until 1881, the lighting of the city was done by kerosene. Since that year electric lighting has gained a strong foothold, and year after year has seen larger and larger districts of the city illuminated by electricity. The total amount of the contracts with the three companies, without figuring on any increase in the number of lights, is $291,298.20, which is an average of $50,259.85 per annum. These figures are significant in the showing they make in the steadily increasing popularity of the electric light, and are especially significant in view of the fact that the three electric light companies have been in competition with the three gas companies.

—— The contract for building the electric observatory for the Worcester Polytechnic Institute has been awarded to Darling Brothers, of Rochdale, for $3,565, according to plans by Stephen C. Earle, architect. Work will begin at once, and the building is to be ready for occupancy November 1st. It is to be located near the southeast entrance to the grounds, and is to be built of Millstone Hill stone, with dressings of Longmeadow brownstone. It will consist of a rectangular room, about 15x20, with round turret, designed to accommodate a transit instrument. The axis of the main part of the building will coincide with the magnetic meridian. The purpose of the building is to afford facilities for conducting the most delicate electrical experiments. No iron will be used in its construction, and the location is chosen so as to be as remote as possible from disturbing elements.

Practical Electrical Measurement.

The efficiency of dynamos and motors used till lately to be tested by means of dynamometers and brakes. To test a dynamo its power was supplied through a transmission dynamometer, and the out-put was measured by suitable instruments, and the gross efficiency was thus obtained. The drawback to such methods is that few people have dynamometers, and the loss in the conversion of the mechanical into electrical power is too small to be measured by such means; in fact, the errors arising in the dynamometer might easily be greater than the whole loss in conversion.

Such rough methods have been superseded by more simple, and at the same time more scientific means.

Dr. Hopkinson's method is well known, as as it has been frequently described. He couples a dynamo and motor together rigidly, so that one can turn the other. The motor drives the dynamo through the rigid coupling, and the dynamo gives back most of the power electrically to the motor. The loss in the two machines is supplied by a small belt with a transmission dynamometer. As the power supplied to the system by the belt is only a small fraction of the whole power to be measured, any slight inaccuracy arising from the use of the transmission dynamometer is insignificant in comparison with the power transmitted through the motor shaft. The electrical measurements are, of course, capable of great accuracy.

Shortly after the publication of the tests of the Edison-Hopkinson machines by Dr. Hopkinson's method, the writer discussed with Mr. Crompton several methods of coupling up machines wound in different manners, so that the lost power could be supplied electrically instead of mechanically. These methods, or mentioned there by Mr. Crompton. Lord Rayleigh almost immediately afterwards proposed in this journal to supply the power electrically instead of mechanically.

The publication of the Manchester tests also brought out the information that Capt. Cardew used to use a method of testing in which all the measurements are electrical. The dynamo supplies electrical power to a motor, and this power is measured by suitable instruments. The motor then drives a dynamo, and the output of the dynamo is measured. From these data the efficiency of the machines can be calculated.

Various modifications have been proposed, differing chiefly in detail. The drawback to Hopkinson's method is that it is not applicable unless there are two similar machines to be tested, and this is seldom the case; moreover, it would not do well for small machines. Capt. Cardew's also demands three machines, of which two must be adaptable as dynamo and motor, and must be large enough to run the other at full load.

The writer has brought out a system in which, besides the machine to be tested, only a comparatively small dynamo is necessary. This system is so much simpler and so much more generally convenient, that it will be fully described without further discussion of the other methods.

There are several distinct sources of loss in dynamos and motors, namely, loss in overcoming the resistance of the wire on the armature and field magnets, loss in mechanical friction in the bearings and against the air, loss by reversal of magnetization of the armature core, and loss by eddy currents in the armature core, and in the armature conductors in large machines, and in some cases in the field magnets. The loss by resistance of the conductors in a machine can be calculated, and the whole loss in the machine can be also determined; the difference between these gives the loss by friction and by eddy currents and reversal of magnetization, but as these losses cannot well be separated they may be all treated together and called the stray power.

The stray power is determined by exciting the field magnets so that the armature has the same induction as at full load, the electromotive force on it being such that it goes at its normal speed. The power taken to drive it is equal to the stray power at full load.

Take, as an example, a shunt-wound dynamo, giving 100 volts and 500 amperes at 950 revolutions per minute. Suppose the shunt resistance is 12 ohms and the armature resistance is .006. The armature loss is then the square of the armature current multiplied by the resistance, or $(508)^2 \times .006 =$ 1,548 watts. The loss in the field is $100 \times 100 \div 12 = 833$. To determine the stray power it is necessary to find the armature electromotive force at full load. As the resistance is .006 and the current 508 amperes, the loss is 3; so that the armature electromotive force is 103 volts. The little dynamo must, therefore, be arranged to give 103 volts, and the dynamo to be tested must be run as a motor by it. It will, of course, run at less than 950 revolutions, as the field will be over-excited, and there will be no back induction. Resistance is then inserted in the shunt circuit till the speed reaches 950. The electromotive force and current through the armature are then measured, and their product is the stray power. Suppose, for example, that the readings are 103 volts and 9 amperes, the stray power is then 927 watts.

By back induction the writer means the negative induction due to the armature wire, which opposes the induction due to the field circuits; that is to say, the effect of the current in the armature wires included in twice the angle of lead of the brushes.

It is, perhaps, hardly necessary to say that induction is used in more than one sense, and that back induction has nothing to do with self-induction. There is a popular error to the effect that self-induction is in some way or other a source of loss of power in a dynamo. There is no loss of power by self-induction; from the nature of self-induction such a thing is unthinkable. Self-induction can no more cause a loss of power, or a back electromotive force, than a fly-wheel can absorb power in an engine.

Taking the loss as 1,548 in the armature, 833 in the fields, and 927 stray power and 50,000 as the output, we get the total power supplied by the belt = 53,308, so the gross efficiency is $50,000/53,308 = 93.8$ per cent. As a dynamo, the electrical efficiency is $50,000/52,381 = 95.5$ per cent., and the efficiency of conversion is $52,381/53,308 = 98.3$.

To find the efficiency as a motor, we must find what the machine will do as a motor. It may be run with 100 volts on the terminals, in which case it will not run at 950 revolutions, because with 100 volts on the field that gives 103 armature volts, which would take 106 terminal volts. It would therefore run at 895 revolutions with 100 terminal volts. We may, however, assume the same speed, but imagine the shunt wound so as to give the same ampere turns with 106 volts, in which case its resistance and the electromotive force on it are both higher, but the power absorbed is sensibly the same, namely, 833 watts. We then have also the same loss in the armature, as the armature current will remain 508 amperes, the armature having had that current before. The stray power also remains the same, namely, 927 watts. The motor thus receives $106 \times 508 = 53,848$ watts supplied to the armature and 833 to the fields, making 54,781. Of the power given to the armature, the power equal to the product of the current and back electromotive force, viz.: $103 \times 508 = 52,324$ watts, is converted into mechanical power. Of this 927 is lost as stray power, so 51,397 watts are available on the pulley of the motor.

The conditions as a motor are then 106 volts, 516 amperes, as the shunt still takes practically 8 amperes. The electrical efficiency $= 52,324/54,781 = 95.7$ per cent., the gross efficiency is $51,397/54,781 = 93.7$ per cent., and the efficiency of conversion is $51\,397/52,324 = 98$ per cent. The differences between the efficiencies as a motor and as a dynamo are due merely to the way of taking them. The differences are small in this case, because a machine of high efficiency has been taken, but in the case of a small machine the difference would be greater; just

as the difference between discount and premium increases with the percentage.

If the machine is compound or series wound, of course it is equally easy to test the machine. A series wound machine must of course be separately excited for the determination of the s ray power.

Compound motors need not be considered, as there is no use in winding such things. The shunt motor, if properly designed, and properly wound, runs at practically constant speed, not only with varying load, but with varying electromotive force on the terminals.

The efficiency of conversion really depends very much on the oil used, and is never a fixed quantity that can be accurately determined.

Of course, the efficiency, as well as the output, is not a property inherent in a machine. People often talk of such and such a machine as having an efficiency of 90 per cent., and an output of so many watts, but such expressions are to a great extent meaningless.

A great deal of harm is done by the growing custom of making slow speed dynamos. In some cases saving space is so important a consideration that it overrides any objection there may be to direct driving, but in most cases slow speed dynamos are a great mistake. A machine which will at 1,200 revolutions give 50,000 watts with an electrical efficiency of 94 per cent. loses 5 320 watts. If it is run at 400 revolutions its output is $55{,}320/3 - 5{,}320 = 13{,}120$ watts only; and its efficiency will be only 71 per cent. A slow speed machine for a given output is therefore not only larger, but even then has a low efficiency. The loss by using a slow speed machine is very much greater than that of an intermediate shaft, and the first cost is also very much greater. It is just as absurd to run a slow speed dynamo as it would be to run a steam engine or gas engine a third of its normal velocity.—*London Electrical Review.*

The Woonsocket Electric Railway.

The new electric railway in the city of Woonsocket, R. I., will be operated by the local electric light company, with an overhead system of wire, built by the said company from designs furnished by and under the direction of the Bently Light Company, who also furnish the other apparatus, including a 15 horse power motor, built by the Thomson-Houston Electric Company, of Boston.

The generators to furnish the current are of 400 volt each, and are also built by the Thomson-Houston Electric company.

The company expects to start a car over the first completed mile of wire this week, and should be pleased to have any representative of the electrical press witness the actual running of what they claim is the first electric street car designed for permanent use over a New England street railway.

Multiplex Telephony.

Dr. Tommasi, writing in the *Moniteur Industriel*, describes a method of utilizing a single wire for the simultaneous transmission of a considerable number of telephonic conversations between distinct exchanges. The method is based upon the phenomenon of the persistence of the sensation of sound (analogous to the well-known persistence of the sensation of light upon the retina). That an effect of this character does exist is evident from the fact that we hear musical tones of above 16 (double) vibrations per minute as a continuous sound, and not as a succession of waves such as really exist in the atmosphere. Dr. Tommasi, therefore, proposes to make use of the principle employed in multiplex telegraphy and to cause rotating cylinders to make successive contacts between the several lines which are to be joined, each contact recurring in less than one thirty-second of a second. The cylinder must therefore rotate at a rate of about 2,000 revolutions per minute. It is further necessary that at the opposite end of the single line wire a similar cylinder be maintained in absolutely synchronous rotation, so that the two cylinders shall always connect the same lines at the same moment. Dr. Tommasi suggests that the first cylinder should be driven by a small electro-motor, and that the synchronism of the second should be maintained "by one of the well-known methods." It is doubtful whether there is any known method by which this can be done other than Delany's adaptation of La Tour's "phonic wheel." In this case (as Dr. Tommasi points out) it will be necessary to run a separate circuit for the performance of this regulation. It must be admitted that the method does not appear very promising, because the make and break of the circuit at the rate of thirty-two times a second will itself give rise to such a noise that we can hardly expect that conversation can be conducted with any degree of comfort, even if it is possible at all. This difficulty seems to us a very grave one; if, however, it can be overcome, we should be inclined to anticipate an important future for Dr. Tommasi's device. Only last week we mentioned that there are now twenty-five telephonic circuits in use between New York and Philadelphia, and it is obvious that any method which promises to do the same work with only two circuits is decidedly worth consideration. In the north of England, again, there are several trunk lines upon which (although neither so long nor so heavily wired as the Philadelphia route) the profits are yet nearly all swallowed up in the cost of maintenance. So that here again a reduction in the wire mileage would probably afford perceptible relief. We may add that Dr. Tommasi hopes to find that in practice it may be possible to work at a lower number of revolutions of the cylinder, because it may turn out that the diaphragm of the receiver has, by reason of its elasticity, a tendency to perform a larger number of vibrations than that due to the actual impulses of the magnet.

Electric Transmission of Energy in Mines.

A somewhat remarkable, and, so far, successful application of the electric transmission of energy has recently been carried out in a coal mine near Normanton, England. The motive power required for pumping water to the surface has hitherto been furnished by compressed air; but the engineers in charge were so dissatisfied with the low efficiency obtained—an efficiency not exceeding 25 per cent.—that they determined to try electric power. The pumps are situated at a distance of about 70 yards from the bottom of a shaft 300 yards in depth; and owing to the damp atmosphere and confined space the conditions were of a peculiarly trying character for electrical machinery. A second pump is now about to be fixed. When the plant has been a little longer at work, and may be presumed to have reached its final stage of development, we hope to give a detailed account of the whole installation, which our readers will probably find to be of considerable interest.—*London Electrician.*

The Muthel Differential Arc Lamp.

The attempts which have previously been made to construct an arc lamp with two equally inclined carbons, says the London *Electrician*, have not met with a great deal of success. This principle has, however, such obvious advantages in the way of freedom from shadow and the distance of the arc from the structural supports, that were it not for pure weariness of chronicling the endless modifications of arc lamps, we might be disposed to welcome any renewed attempt giving reasonable promise of success in this direction. The Muthel lamp appears to us to be such an attempt; the principle can be described in very few words. The carbon holders are attached radially to a pair of pinion wheels which gear on either side of the same rack. When the rack descends the carbons are inclined towards one another, when it ascends they are further separated. The pinions are mounted eccentrically upon a pair of heavy cams which tend by themselves to bring the carbons together. The rack is fixed at its upper end to an iron core, which travels in a double solenoid. The upper half of the solenoid forms a shunt circuit to the lamp, and tends to pull the rack upward, and so bring the carbons together. The lower half of the solenoid is in the direct circuit, and tends to lower the rack and separate the carbons; this is the action which strikes the arc. It is probable that the lamps of this type are better adapted for alternating than for direct currents.

Transmission of Energy—Compressed Air vs. Electricity.

The Times of August 24th contained an elaborate eulogy of the system of transmitting energy by means of compressed air; and, indeed, if commercial considerations be neglected, we should be disposed to agree with most, if not all, the writer says. That still more sapient oracle, the *Pall Mall Gazette*, evidently supposes that compressed air is a brand new invention, and, after reading the account, thus learnedly comments thereon: "It is a good instance of the busy march of science in these days, that while electricity is only on the threshold of its applications, a rival power should already be in the field—the substitution of air for steam! It would require volumes to expound all that would be meant by such a change," etc. Without employing "volumes" of vapor upon the subject, we would invite the attention of the *Pall Mall Gazette*, as representing the average non-technical mind, to the following facts and figures, premising only that cost is usually an essential consideration in matters of this kind. It has recently been shown by a writer in the French journal *La Genie Civil* that the efficiency of transmission by compressed air cannot exceed 45 per cent. for distances of about a quarter of a mile, while beyond this it is still less, and that the system is necessarily dearer than transmission by water pressure, except for distances exceeding about three miles. The calculation is based upon a total transmission of 100 horse power. Now (quoting from the same writer), let us compare each of these methods with the cost of transmission by electricity and with wire ropes. The result is shown in the following table, where the original source of power is (1) steam, (2) turbines:

Motor.			Steam.		Hydraulic.	
65,620 Feet.		*d*	4.61	9.57	6 39	12.68
32,810 Feet.		*d*	2 84	5 79	5.25	4 99
16,400 Feet.		*d*	2.27	4.03	4.05	2.88
3,280 Feet.		*d*	1.94	2 61	3.33	1.58
1,640 Feet.		*d*	1 84	2.36	3.23	1.49
330 Feet.		*d*	1.80	2.27	3 17	1.26
System employed.	Electricity		0.40	0.47	0.77	0.26
	Water pressure		1.15	3.54	3 36	3.39
	Compressed air		0.68	2.23	1 86	1.42
	Ropes		0.62	1.33	1.21	0.80
	Electricity		0.48	0.55	0 80	0.27
	Water pressure		0.53	0.62	0 84	0.30
	Compressed air		0.62	1.33	1.21	0.80
	Ropes		0.40	0.47	0.77	0.26

It will be seen that for 100 horse power compressed air is absolutely the most expensive method in all cases. For distances less than 16,400 feet, wire ropes are at first cheaper, while beyond such distances electricity comes rapidly and unmistakably to the front. But immediately we contemplate, not merely the transmission, but also the distribution of energy, ropes are altogether out of the question, and cannot for a moment compete with electricity for convenience and ease of handling. Relative calculations of this general nature do not, of course, pretend to anything more than an approximate degree of accuracy; but it may be stated that similar calculations by independent authorities have invariably given results of the same general character. (See, for instance, the valuable tables in Kapp's "Electrical Transmission of Energy.") The proof of the pudding is, after all, in the eating, and it may astonish *The Times* and the *Pall Mall Gazette* to learn that in America there are already in active operation about 10,000 electro-motors, of which the great majority receive current from central stations for the distribution of light and power. Such stations number about 250, scattered in almost as many different towns.

Statistics of Electric Railroads in Europe.

TRANSLATED FROM THE "ELECTROTECHNISCHE ZEITSCHRIFT" FOR THE ELECTRICAL REVIEW, BY F. B. BADT. TABULATED TO APRIL, 1887.

PLACE.	Length in Kilometers.	Number of Motors.	Total Running Expenses.	Kilometers Traveled in One Year.	System of Conducting Current.	Motive Power.	Built by
Lichterfelde, Berlin, 1881.	2,450 meters, single track.	2 electr. cars.	30 pfennig * per car kilometer.	24,000	Rails.	Steam engine.	Siemens & Halske.
Frankfurt, Offenbach, 1884.	6,660 meters, single track, 5 switches.	10 electr. cars, 2 cars to hitch to electr. cars.	25 pfennig per car kilometer.	470,340	Slotted pipes over ground.	do.	do.
Mine: Zaukersole, 1882.	700 meters, single track.	1 electr. locomotive, 15 cars.	8 pfennig per ton kilometer. †	700—800 cars daily. ‡	T iron conductor fastened to ridge of gallery.	do.	do.
Mine: Neu-Stassfurt, 1883.	1,100 meters, single track.	2 electr. locomotives.	.....	1,200 cars daily. §	do.	do.	do.
Mine: Hohenzollurn, 1883.	1800 meters, single track.	3 electr. locomotives.	5 pfennig per ton.	2,000 cars daily. ‖	do.	do.	do.
Munich, Schwabbing.	776 meters.	2 electr. cars.	.....	.....	Rails.	do.	Schuckert.
Rosenheim.	700 meters.	1 electr. locomotive, 3 cars.	.....	.....	Aerial line.	Water.	do.
Moedling (Vienna), 1883.	6,300 meters, single track, 5 switches.	5 electr. cars, 5 others.	.....	.....	Slotted pipes over ground.	Steam engine.	Siemens & Halske.
Brighton, 1883.	1,000 meters, single track.	2 cars.	.....	47,000	Rails.	Gas motor.	Magnus Volck.
Portrush, 1883.	9,600 meters, single track.	4 cars.	.....	.....	T iron over ground, return through rails. ¶	Turbine wheel.	Siemens Bros.
Besspool, 1884.	3,000 meters, single track.	8 cars.	32 pfennig per train kilometer.	60,000 car kilometers.	Three rails.	Water.	Mather, Platt & Hopkinson.
Blackpool, 1884.	2,000 meters, double track.	10 cars.	30 pfennig per car kilometer.	.....	Subterranean.	Steam engine.	Holroyd Smith.

* One pfennig equal to about ¼ cent.
† Three years' average.
‡ Load of 450 kilogrammes each.
‡ Weight of car without load, 575 kilogrammes; gross weight, 1,175 kg.
Weight of car without load, 450 kilogrammes; gross weight, 975 kg.

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We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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CONTENTS.

	PAGE
A Large Battery of Storage Cells	1
Cooking by Electricity	1
Fishing by the Electric Light	1
Long-Distance Distribution	1
Practical Electrical Measurements	2
The Woonsocket Electric Railway	3
Multiplex Telephony	3
Electric Transmission of Energy in Mines	3
The Muthel Differential Arc Lamp	3
Transmission of Energy—Compressed Air *vs.* Electricity	3
The Electric Crank Again Heard From	4
Insurance Rates on Central Stations	4
Electric Signal for the Engineer	4
Our Chicago Letter	5
The Van Rysselberghe System	5
Self and Mutual Induction on Telephone Circuits	5
Telephonic News	6
The Telephone in Australia	6
The Rise and Progress of Telephony in Great Britain	6
Compressed Air for Electric Lighting	6
The "Sting" Monitor Bell	6
Dunder's Telephone	6
Lighting Railroad Cars by Electricity	7
Telephone Voices	7
Welding by Electricity	7
The Telegraph in England	7
The Heating and Lighting of Railway Cars. By Paul Goepel	8
Singular Action of Two Galvanic Couples in One Cell	9
A Scoundrel's Ingenious Attempt to Use Electricity for Revenge	9
Prof. Forbes on Primary Batteries	9
Another Carbon Works	9
Electric Light News	9
Electrical Patents	10

The fall crop of electrical inventions promises to be large.

Mr. W. R. Caulkins is the general manager of the new carbonaceous offshoot of the T.-H. parent company. We cannot say, "more power to your elbow, Mr. C.," for you have more grip than your share now. But when you stand under the burning rays shed by your millions of carbons, we heartily wish "more hair to your head, Mr. C."

Science of August 19th contains a number of discriminating reviews of electrical works. This reviewer wields a sarcastic pen. Touching Levéy's "Electric Light Primer," he says: "The 'practical man' here has full sway, and he wisely declares in his preface that it 'is not supposed that these pages will be of any value to the electrician.' They would have been of much greater value to the workmen and engineer in charge of electric machinery if they had been prepared by one who really understood what he was writing about."

M. de Lavison has discovered that vulcanized fiber, especially the flexible variety, when it has been submerged some time in a liquid, acquires all the properties of a good porous cup, is very thin, cannot be broken, and is easy to make and take care of. Besides, it has the advantage of very low electrical resistance, very much less than ordinary cups of clay—a very remarkable fact, since the dry fiber is such a good insulator. This discovery seems capable of numerous applications in all batteries which do not contain concentrated sulphuric acid, nor solutions of bichromate of potash and soda, all of which attack the vulcanized fiber.

Mr. Geo. H. Hartwell, of Boston, begins his regular lecture season in October under the mangement of Major J. B. Pond, of New York. Mr. Hartwell is the pioneer lecturer on the interesting phenomena of electricity relating to light and power. Not a single college or technical school is supplied with the equipment sufficient for the experiment which he performs during each lecture. For the coming season the lectures have been recast, and novel experiments and apparatus devised. A ½ horse power storage battery of 60 cells will supply the current used during the lectures for driving a ½ horse power motor, and operating arc and incandescent lamps. By the motor a small dynamo can be set in motion. This is connected with a line of lamps illustrating street lighting by incandescence. Among other fantastic effects an orguinette will be operated. More instructive and entertaining lectures could hardly be devised.

THE ELECTRIC CRANK AGAIN HEARD FROM.

The occasional crank turns up again smiling with triumph. (Cranks are made to turn, we know, but editorially they ought to turn round half way and—go out.) This particular crank has been turning and grinding, and ground out a brilliant invention. He proposes to furnish smokers with a thermopile and storage battery, the former for attachment to his cigar and the latter for concealment in his "inside pocket." As he leisurely smokes he can puff out whiffs of satisfaction that he is storing up electric energy right along. With a constantly ready store of electricity in every man's pocket, what possibilities exist, only the crank's cousin, the statistician, can tell. The theme of utilization is hydra headed. Coupled with a small electric lamp, what a handy key-hole finder on club nights! Helped by a small induction coil and electrodes placed in one's palm, what gentle thrills of tingling love could be made to undulate through a best girl's arms when the beau visits her; and after marriage how nice to double up for intensity and knock-down throbs, and then shake hands every morning with the mother-in-law. But a horrible idea comes forward. Suppose, while smoking a fine regalia and inhaling its delicious nectar, one happened to swallow a volt or get an ampere stuck crosswise in his throat. The consequences are too horrid to contemplate.

INSURANCE RATES ON CENTRAL STATIONS.

While sitting in the office of an insurance company, and conversing with one of the officers on the subject at the head of the article, he conceded that the insurance rates on central stations were not only excessive, but even higher than would perhaps be warranted by a strict consideration of the facts in the case governing the actual fire risk; and said he: "There are two elements which should be considered—the one of consideration to the underwriter, because the risk on electric illumination is, as far as our tables go, practically nothing; and the best informed people on the matter state that the hazard of electric lighting is, in a great measure, controllable by the skill of those engaged in installing the plan and management and apparatus; but there is such a difference in these elements of risks, that electric lighting may be either very dangerous or well nigh absolutely safe.

"But when an insurance company takes the risk on the whole property, being ready, in consideration of receipt of a moiety of its value, to replace the whole amount, it takes a great risk on a very uncertain means of ascertaining the exact measure of that hazard.

"We have what is sometimes called the moral hazard of a piece of property; which in plain English means, Has a man the disposition and nerve to burn his own property?

"In the case of electric lighting apparatus under the conditions named above we have a more equal way of dealing with the measure with the knowledge and skill of those engaged in the business On the other hand, there is much in the great hazard of electric lighting property in central stations, which has been entirely chargeable to the electric interests themselves.

"They will go into contracted quarters, and lease some old building of poor construction, with all the elements tending to favor the destructive spirit of fire, should one occur from the hazardous exposures surrounding the building, or from hazard in the building; and it would be considered a poor fire risk independent of the electric lighting apparatus.

"There is no reason in this day of distribution of incandescent lighting by converters, why an electric station should not be put in the most advantageous place, as far as can be obtained, with reference to the conditions of ready supply of fuel, supply of water for condensing the steam, and favorably exempt from hazard of fire from outside sources, by putting it in a position where it will be isolated from other buildings.

"Now," said he, opening a file of inspections, "here I have a description of nearly every electric lighting station in this part of the country, and have looked up the causes of fires which have destroyed those stations; and according to the best information, every one of them has been destroyed by causes entirely independent of electricity; and also that the buildings themselves contained elements of criticism from an underwriter's point of view. I have here," said he, "a report of inspection of an electric station, made three days before it was destroyed by fire; and I will read it to you, just because humanity likes to say, 'I told you so.'

Reading from the report: "In regard to the boiler house, I cannot consider it as safe as such property ought to be.

"There is a space of about 6 inches between the east wall of the station and the wall of the building, in which various things are liable to fall and cannot be reached for the purpose of clearing out; and bits of oil waste might cause a serious fire, which would be sure to reach also the brick wall between the boiler house and dynamo room, which only extends the width of the boiler, and, in case of fire, would not serve any purpose as a cut off. From the main building the plastering has fallen down in several places, and the bare laths are within three feet of the boiler. The least distance which would be admissible would be five feet unless the wood work were protected by asbestos paper and tin.

"The wood work which supports the dynamo room from the boiler room directly over the rear of the boiler is warped out of shape at least three inches; showing that it has been exposed to considerable heat.

"There were two barrels of oil in the boiler room, not kept in a very clean condition, and oily waste is left in several places, both upstairs and down.

"There are no acts or evidence of any systematic provision for taking care of the oily waste. The glass bottles with extinguishing compound are of the kind have been shown, by practical experience, to be of little service; and several buckets of water should be kept on each floor.

"There is no provision for the use of the city water by hose, which could be fastened on to faucets or small hydrants, which could be put in any other part of the building."

Now that electric light station burnt three days after that inspection was made, and the fire started in the rear of the boilers, which the inspector had criticized as dangerous.

Another instance of an electric lighting station fire was that of the station where sawdust was used in great quantities to absorb the oil on the floor, which was a slovenly method of keeping a station. In course of time a fire started from an outside cause in another room of the building, and communicating to this sawdust, caused a destructive fire.

Another instance was that of an establishment formerly used for readering of lard oil, and was converted into an electric light station with the least possible amount of change; and very naturally a fire from an outside source consumed the oil-soaked building in spite of all appliances of fire apparatus that could be used.

Now, the destruction of this building was virtually that of an oil establishment, except that its contents were of greater value.

The electric lighting interests should take a lesson from this, and place their stations in isolated localities and building them on solid construction destined to withstand fire and permanently resist the disintegrating elements of the vibration of the electric lighting apparatus, and in this manner operate under the most advantageous electrical and mechanical conditions, and the causes producing these conditions would also reduce the fire hazard, and the insurance rates would diminish accordingly in accordance with the competition among underwriters, which approaches the minimum limit of profit to capital, in obedience to commercial laws, as truly as any other business which trades in merchandise.

ELECTRIC SIGNAL FOR THE ENGINEER.

Mr. T. H. McIntosh, an engineer on the Oregon Railway and Navigation Company, and W. F Wamsley, train dispatcher at Walla Walla, have applied electricity to signaling from the train to the engineer. The conducting wire runs through the air brake hose, and whenever the hose is connected the wire is connected also. A small rope running the length of a car near the ceiling serves to close the circuit and ring the bell. On long passenger trains there is a great deal of slack to the bell cord, and a conductor near the rear end can't tell just how hard to pull to ring the bell; the rope often breaks or knots, and in stormy winter weather freezes. The beauty of the electric signal is that it requires no additional coupling. The air-brake hose must be coupled, and this serves the electric wire. There is no such thing as forgetting it.

Now that air brakes are coming into general use on freight trains, the invention will be of great benefit, for by placing a small additional battery in the caboose the engineer and conductor can signal each other. In case a train parts, the electric circuit closes, and both engineer and conductor are instantly notified of the occurrence by the unbroken ringing of the bells, and they can thus, through immediate notice, avoid accident.

What a valuable invention the electric trumpet with a ten mile range would be to the stump speaker!

OUR CHICAGO LETTER.

(From a special correspondent of the ELECTRICAL REVIEW.)

"Here we are again," as the clown says when the circus performance commences. This time the remark applies to a chap in some land of benighted reporters where startling facts are published at so much a line. A two-horse engine, occupying an insignificant corner of a room, runs a dynamo which is a little larger than a waste basket [which, it may be remarked, is a trifle smaller than an ordinary lump of chalk] and furnishes the power for four arc lamps of 2,000 candle power each. It also runs thirteen glow lamps of 16 candle power, two of 25 candle power, two of 30, one of 125, and one arc light, while it operates a sewing machine from a small motor with almost fierce rapidity. This dynamo is self-adjusting; turning on or off lights makes no difference with the brilliancy of those remaining, etc., etc. [here follow all the old remarks which are applicable to any system claiming to get more out than it puts in in the way of power] and the great problem of how to light your dwelling economically, practically, and safely, etc., is solved.

This is the light that children cry for!

Old maids desire it, and bachelors will have none other. Married people endorse it; priests, parsons, and preachers prefer it. Beware of counterfeits See that our name is on the wrapper. For particulars, estimates, plans, etc., apply ———; this is not the advertising column of the REVIEW.

And again, here is another form of arriving at or attempting much the same result in another section. The plan proposed has not yet arrived at the advertising stage, but may, in the future.

A sudden and startling departure is made by a Western inventor, who despises technical knowledge, especially in electricity—"which is so uncertain, don't you know?"

His system embraces four or more field magnets, which are stationary. Revolving between these, in a method peculiar and original, are coils arranged so that one after another of these are influenced by the inductive action of the fields. That is, the field sets up induction in coil *a*, and this in turn acts on coil *B*, *B* on *C*, and so on, these being all concentrated afterward. One is reminded of the old lines about the parasites:

> 'Tis said that fleas have lesser fleas,
> And these have lesser still to bite 'em,
> And even these have lesser fleas,
> And so, *ad infinitum*.

Now, all the argument which could be brought to bear was powerless to prove the fallacy of this old and exploded attempt to get something out of nothing, or of increasing an original investment without adding to it—burying a stocking full of silver dollars, and compounding an imaginary interest on them. The old illustration of 1728 cubic inches of water arranged in a multitude of forms, from a cube to a column, didn't please him. An original comparison, combining geometry and mathematics, was equally powerless for his good, and he finally departed from the seance, firm in the belief that this world is a world of fools, determined to risk his last dollar in a set of experiments.

It is another case where the man who lifts a ton or so forgets, as he pulls the rope, how many feet he pulls to move the weight a half inch; where the good old grandmother can't understand that the power she puts into the clock by winding runs it for a week; that when she toddles up-stairs she lifts her body from the floor to the ceiling—and more—of the room she started from—in short, the fact is ignored that nature does no trust business. She gives an equivalent in all cases—no less, no more, except that she charges a trfling commission, in the way of loss through conversion. That's all.

"Honest, but close, she is too sharp a trader to give more than she receives, in life or health, in pleasure, pain or power."

Cyclonic storms have been having a vacation for some months now—presumably summer breathing spells. With the return of the excursions, they are back again, ready for business, refreshed by their rests.

One of these atmospheric cork-screws started the other day at Adrian, Michigan, and waltzed down toward the lake, leaving a tipsy and desolate track in its wake. Sylvania and Ottawa Lake were pretty effectually leveled. When the storm reached Toledo, Ohio, it tore down the trees in the fair grounds, leveled the buildings, and played the dickens with the exhibitors. An insane asylum was damaged many thousands of dollars. Torrents of rain accompanied the storm, and the total damage to the establishment, which is a village of some forty cottages, is about $8,000. Then the storm crossed the Maumee river, and failing to get across the track ahead of a coming train, it twisted the smoke-stack off the engine, as a sort of a reminder to "wait next time, and not try to interfere with the procession, when you know it is in a hurry."

The genuine showman—the natural-born dealer in freaks—is one who can come as near making his foresight equal to his hindsight as a lucky dealer in stocks. He baits his traps and secures his game with little excitement, but with unerring certainty. He is in the field this year a trifle in advance of the season, but you may wager your bottom dollar the reason will become apparent in the near future. Here he is:

"A Belgian cabinet maker, employed at a shipyard and living all alone, has the wonderful power of producing electric sparks by rubbing his fingers. His motions prove that he is excessively nervous, and his senses of hearing, sight, and smell, as he assured a reporter, are unusually acute. He is the youngest of a family of eleven children.

"I know not how I do it," he said last evening, as the reporter saw sparks shoot from his fingers. He rubbed his finger tips rapidly up and down upon his pantaloons. Then, holding his hands out, with the fingers widely extended, jets of tiny yellow flames or long sparks shot out. They seemed propelled by some unseen force, ten or twelve inches into the air, when they vanished. The right hand appeared more charged with electricity, if the sparks are electric, than the left. It was a wonderful sight. Again and again did the bushy-headed Belgian rub his fingers and hold them out, while tiny showers of bright sparks darted out as if from toy fireworks.

"I was not always so," said he, lighting the lamp and his black pipe, filled with villainous tobacco, at the at the same time 'When I was sick, ten years ago, it was said I would die. I lay very weak one night, in my father's house, when there came up a storm. Such thunder and lightning I never knew before. And my body had such queer sensations. While I lay covered up with bed-clothes, my mother sat holding her face in her hands by my side, and I seemed to feel a thousand needles pricking my limbs and chest and the soles of my feet. It was not so painful, for queer thrills came with every prick, and when the thunder rolled away and the rain stopped, I rose up, leaned back, and put out my hand to take that of my mother's. My eyes were closed, but I heard her cry, 'Anton!'

"'What?' I gasped weakly.

"'Your hand.'

"I looked at it. The one nearest to her. It was aflame. God preserve us. I was terrified. My cry brought my father and sisters to the room. They looked at me in horror. I took my other hand from the clothes to rub my right. Sparks shot from the fingers of the left. Soon they died away, but I have but to rub my hands as you have seen and the lights come."

When the chilly wintry days admonish us that Lent will soon be here, when amusements of a more robust nature will be denied the pious section of this wicked world, we will wander into some dime museum, and there behold the verification of the Belgian cabinet-maker's wonderful gift; while the show-bill printing house will be thundering away with its labor of getting out the monster next summer circus bills, representing the unfortunate mechanic, frightening the people with electric flames anywhere from a foot to a rod in length, for the only great and something or other aggregation of seventeen shows under one tent," and so on.

Cut this out for reference, and don't forget the date.

The regular meeting of the Chicago Electric Club was held at the club rooms on Monday evening, the 5th. In the absence of the president and vice-presidents, Mr. F. B. Badt was called to the chair. Mr. C. C. Haskins read a paper on peculiarities of electrical currents, illustrated by experiments which were all conducted with the aid of the audience. The apparatus consisted of a battery of half a dozen jars, a set of dynamo field magnets, an alternate and direct current magneto, a solenoid, a core, a bar magnet, and Rhumkorff coil.

Mr. Haskins arranged his audience in a semi-circle, so as to place all present in circuit with two permanent terminals upon the table. Manipulating the various connections upon the table, he succeeded in demonstrating to all, physically as well as orally, the different forms of current: The direct battery current—which could not be felt—then the same with an electro-magnet, showing the effect of the extra current—the same with an automatic circuit breaker—direct and alternate currents from the magneto generator, the induction current from an eight inch Rhumkorff coil, a very little of which it was concluded would go a great ways personally, and finally a very pretty lesson in induction by means of a permanent magnet, a solenoid and an astatic needle. The apparatus was loaned for the occasion by the Electrical Supply Company, the Western Electric Company, and the U. S. Electric Lighting Company.

A vote of thanks was accorded the speaker, whose paper was highly appreciated and elicited very general discussion, and the conclusion arrived at was that if three one-hundredths of an ampere of current in a primary could shake people up in that style there was very little necessity for investigating in the same manner with any higher intensities. They all said "enough."

CHICAGO, Sept. 12, 1887.

The Van Rysselberghe System.

The *Bulletin* of the Belgian Society of Electricians contains an interesting communication on the Van Rysselberghe system of simultaneous telegraph and telephone communication, showing the extent to which the system is at present in use. The first experiments were carried out by Van Rysselberghe on the line between Brussels and Paris in the month of May, 1881. A more complete set of experiments were made in the following year between Brussels, Antwerp, and Ostend; but the first practical use of the system was on the line between Amsterdam and Haarlem, a distance of 20 kilometers. This line was opened for the public service on the 27th October, 1883. In the same year the Belgian Chambers passed a vote authorizing the application of the system to the existing telegraph lines. It was not, however, until the autumn of the following year (1884) that the first Belgian line (between Brussels and Antwerp) was finally opened for public service.

Since that time thirty-seven circuits of this nature have been established in different parts of the country, showing a total length of 7,206 kilometers of wire; and it appears that there are in Belgium only 260 kilometers of inter-urban telephone lines which are worked independently of the telegraph. In France the first line was opened on January 2, 1885, between Rouen and Havre. There are now seven lines equipped upon this system, namely, Rouen-Havre, Rouen-Louviers, Paris-Reims, Paris-Rouen, Paris-Havre, Paris-Lille, Paris-Marseilles. The international line between Paris and Brussels has also recently been adapted for telegraph work. Total length of lines in France on the Van Rysselberghe system 4,045 kilometers. There are also about 420 kilometers of inter-urban telephone wires independent of the telegraph. In Germany the following lines are in operation: Berlin-Halle, Berlin-Stetten, Berlin-Dessau, Berlin-Oranienbourg, Breslau-Beuthen, Munich-Augsburg, Nuremberg-Bainberg, Stuttgard-Heilbron, Stuttgard-Broeblingen, Stuttgard-Ulm, Stuttgard-Friedrichshafer—total length of wire 2,512 kilometers. In Austria there is only one line—that between Vienna and Brunn; length 288 kilometers. In Switzerland there are six lines of this character: Geneva-Lausanne (three wires by different routes) Lausanne-Vevey, Zürich-Mannendorf, Bale-Zürich—total length 536 kilometers. In Holland, besides the original Amsterdam-Haarlem line, there are now two others from the Hague to neighboring villages. There is also a line of 55 kilometers between two towns in the Dutch Indies, Weltevreden and Buitenzorg (Java). In Spain there are lines between Madrid, Burgos, Valencia, and Granada. In Portugal there is a line from Lisbon to Oporto, and thence to Cintra; and in Denmark a line will shortly be opened between Rudkjobing and Vanmenas. This completes the list of European lines on the Van Rysselberghe system, which are either already in use or will be opened very shortly. In addition to these, several important lines are projected in Germany, Austria, Spain, Portugal, Italy, Roumania, Russia, Turkey, and Greece, but the work on these has not yet commenced. The following tables summarize the above statements:

	Kilometers.
Germany	2,512
Austria	288
Belgium	7,206
Denmark	10
Spain	140
France	4,044
Holland and Colonies	386
Switzerland	536
Total	15,122

The total length of the lines projected amounts to 5,040 kilometers. The system is also in use to a certain extent in the United States, in the Argentine Republic, in Uruguay, in Brazil, in Venezuela, in Mexico, in China and Japan; in fact, it extends more or less over the whole civilized world, with the glaring exception of England and the British Colonies. We have frequently expressed our own estimate of the value of the system, which is, in brief, that wherever telegraphy is intended to play second fiddle then Van Rysselberghe's system is of great value. If, as in the Paris-Brussels case, we have a line built expressly with regard to the telephone service, there can be no difficulty in working off a moderate amount of telegraphy in addition. But the converse does not hold good, and hence the system is not adapted to the majority of English lines. There is no reason, however, why the system should not prove useful in some of our country districts and in many of the colonies.

The article from which we have prepared the above abstract would have been more useful if it had distinguished in all cases between lines especially built for the double service and old telegraph lines to which the system had been successfully applied. We doubt whether the latter class is a very extensive one.

Self and Mutual Induction on Telephone Circuits.

The *Electrotechnische Zeitschrift* has a paper by J. W. Giltay, in which some experiments upon the effects of self-induction in enfeebling telephonic communication are described. The experiments were more of the nature of demonstrations than of original investigation, and are chifly devoted to exemplifying the fact that the effects of mutual induction are opposed to those of self-induction, because the resultant magnetization is diminished by the currents due to mutual induction. The practical lesson follows that an electromagnet in a telephone circuit should either be surrounded by a sheath of copper or should be shunted by a high resistance without self-induction.

Messrs. Siemens Brothers & Co., of Berlin, have brought out (in Germany) a new microphone, in which they have sought to render the surface of contact of the carbons as extensive as possible. Large plates of carbon are employed, and the lower one is suspended by silk threads, which pass through a hole in the center of the plate above.

Telephonic News

The Telephone in Australia.

The Government of New South Wales has for some time past utilized the telephone as a means of communication between outlying districts, where telegraphic business is not sufficient to engage the whole attention of an operator. The innovation has worked so well that at the present time there are no less than 40 telephone stations in New South Wales. In only two instances, however, has the postal department of Victoria employed the telephone in this manner, and even in these cases it has only been with the object of permitting communication to be maintained with the lighthouse keepers at Point Lonsdale and Cape Nelson. The example of New South Wales, however, is likely to be followed in the future, as several deputations have been promised telephonic communication with stations which cannot now be reached by telegrams.

The Rise and Progress of Telephony in Great Britain.

During the year 1881 the United Telephone Company were busily engaged in the work of extending their operations both in London and in the provinces. By this time the value of telephonic communication was fully recognized in commercial circles, and no difficulty was found in establishing subsidiary companies in various provincial centers. As we intend in the course of this series of articles to give an account of each of these in turn, we shall confine ourselves for the present to the history of the parent company.

In face of this manifest proof of the growth and vitality of the telephone, it was almost inevitable that attempts would be made to contest the validity of the patents held by the United Telephone Company, or else to show that equally good results might be obtained by means which were presumed to lie beyond the scope of these patents. The first action for infringement was brought in the Edinburgh courts in January, 1882, against a defendant named M'Lean, who had made and sold both carbon transmitters and Bell receivers. Inasmuch as the whole case was virtually retried in the English Courts a little later, it will be sufficient for the present to state that both the Edison and the Bell patents were fully sustained, and an injunction was granted against the defendant.

A more serious attack of the same nature was made in the years 1881-2 by a company which established itself in London and commenced to develop an exchange service under the title of the London and Globe Telephone Campany. The instruments adopted by this company were manufactured by Messrs. Harrison, Cox-Walker & Co., and consisted of a receiver identical with Bell's, except that a horseshoe electro-magnet was substituted for the permanent bar magnet, and a transmitter devised and patented by the Rev. J. Hunnings.

Mr. Hunnings commenced to experiment upon telephones immediately after the British Association meeting of 1877, and carried out his investigations upon a line stretching between his own house and the Archiepiscopal Palace at York. Having failed to obtain any satisfactory results from a diaphragm carrying a point which pressed upon a metallic contact somewhat after the Reis type, he succeeded in the following April in transmitting speech by means of a row of cinders, nearly two feet in length, taken from the fire grate. Prof. Hughes communicated the results of his researches on the microphone to the Royal Society on the 9th May, 1878.

A little later, Mr. Hunnings had found that good results were obtained by the use of a quantity of granulated (not finely powdered) carbon in the form of engine coke, and he placed a layer of such particles upon a substantial brass plate, covering them with a diaphragm made of platinum foil. "The reason," says Mr. Hunnings, "that I made use of this oven-made engine coke was because, taken bulk for bulk, its specific gravity was the lightest thing I could find, so that sound waves could move about these particles very easily. He further insisted at the time upon the necessity of the grains being in "a perfectly loose condition," so that they could be easily shaken about. It is tolerably clear that Mr. Hunning's own idea was that the action of the instrument was due to the variation in the number of the grains in electrical contact, as well as in what may be called the average extent of such contact of the several grains. Stress was laid upon this as distinguished from the "pressure" theory of Edison's instrument.

To Hunnings, in fact, as to Berliner, and in some degree to Du Moncel, is clearly due the credit of having constructed what were virtually microphones independently of the researches of Prof. Hughes, but to Hughes alone belongs the honor of having investigated and developed the singular virtues of loose electrical contact. Hughes was the indisputable discoverer of the essential requirements of microphonic action, even although the true theory of the nature of that action is still a matter of dispute.

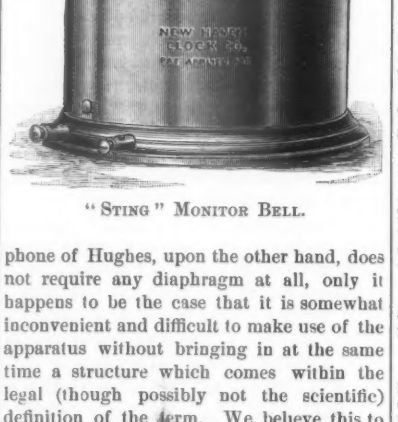
Before proceeding with the story of the fortunes of the Hunnings transmitter in the hands of the Globe Company, this may not be an unsuitable place to discriminate also between the microphone of Prof. Hughes and the earlier "tension-regulator" of Edison, more especially as the Hughes microphone was scarcely mentioned in the legal proceedings which ensued *re* the Hunnings transmitter. It is frequently supposed that Edison employed the word "tension" in its mechanical sense as having something to do with the elasticity of the diaphragm which forms an essential portion of his instrument. In reality the term is employed in the somewhat loose electrical sense which was in vogue at that period, and was intended to indicate that the apparatus, by varying the resistance of the circuit, regulated, or, more strictly, varied, what we should now call the difference of potential between the terminals of the battery. The following is a description of the device in the words of Sir Frederick Bramwell: "The tension device is made of something of semi-conductivity—lampblack, plumbago, or other materials of an elastic character, which can be brought nearer together, and will re-assert themselves when that which brought them nearer together is removed, and a tympan, or diaphragm, which need not be capable of inductive action—it may be of mica, for example—is caused to vibrate by the sound waves produced by the speaker, and in its vibration varies the pressure on the tension device [which] thereby possesses more or less resistance to the passage of the current." Although as regards terminology, this language may not, according to our present lights, possess a high degree of scientific merit, yet it is a perfectly clear and unmistakable description of the nature of the device. The essential point here set forth is the use of a conducting material whose resistance by reason of its spongy (rather than elastic) nature* is capable of variation in very exact accordance with the degree of compression to which it is subjected by the sonorous vibration of a diaphragm with which it is in mechanical connection; such material should also be of high specific resistance, in order that the total amount of variation in the resistance of the circuit may be sufficiently great for the purpose in view.

But the nature and degree of importance of the part played by the diaphragm in an Edison instrument constructed on these lines is more fully set forth by Edison in the specification of the patent. He says, "Many materials have been employed by me, such as metals, horn, vellum, celluloid, ivory, etc., [it is somewhat singular that he does not mention wood] but almost all of these produce a prolonged or secondary vibration from their own resonant character. *Hence the articulation is defective*, and the sound vibrations blend." [Needless, perhaps, to say that the italics are our own.] He then states that mica is employed, as being almost entirely free from these defects. The principal claim in the specification is as follows:

"In an instrument for transmitting electric impulses by sound, the combination with a diaphragm or tympanum of electric tension regulators, substantially as described, for varying the resistance in a closed circuit substantially as set forth."

Considering the immense importance which this claim has subsequently assumed and the wide interpretation to which it has been admitted, it is a little singular that greater stress has not been laid upon the confession italicized above. Edison certainly did not at the time feel satisfied with the employment of a mere "legal diaphragm;" he required, and to his greater credit he sought, until he had discovered, a substance from which a diaphragm having certain specific properties of non resonance could be made. The microphone of Hughes, upon the other hand, does not require any diaphragm at all, only it happens to be the case that it is somewhat inconvenient and difficult to make use of the apparatus without bringing in at the same time a structure which comes within the legal (though possibly not the scientific) definition of the term. We believe this to be an accurate and impartial version of the evolution of the carbon transmitter, and while we cannot but regret that the generous intention of the discoverer of the microphonic principle has been frustrated, yet we must continue to uphold the necessity of bowing to the decision of the legal tribunals of the country as the ultimate appeal in matters of patent right At the same time it is a pleasure to quote the language employed by Mr. Preece in a paper read before the British Association at the Southampton meeting in 1882, and with this quotation we conclude the present chapter. After describing Edison's apparatus, Mr. Preece said: "Prof. Hughes went a step further. He found a combination of materials that were directly affected by sonorous vibrations, which he called a 'microphone,' and he proved that the effect of the carbon transmitter of Edison was not due to any influence of varying pressure on the mass of the carbon, but was a phenomenon of loose contact. He found a new fact in nature, and he startled the scientific world by introducing an instrument which did for minute sounds what the microscope had already done for minute objects."—*London Electrician.*

* This description applies to the use of plumbago, as well as lampblack, because the plumbago was applied by being rubbed upon, or dusted over, silk thread or floss, as set forth in the specification.



"Sting" Monitor Bell.

Compressed Air for Electric Lighting.

To avoid the difficulties and the inconveniences attending the use of steam engines, a strong company has been formed in Paris for the supplying of compressed air to users of dynamo machines for electric lighting. A central station has been provided, where engines of 3,000 aggregate horse power will compress the air for this purpose. The mains are already being laid, and the work is being pushed on with all possible speed to furnish motive power to the theaters, within the time allowed by the Government order, for the substitution of electric light for gas. With electric lamps and compressed air engines, the maximum of safety from fire will be attained. The offices of the *Figaro* are to be the first to be lighted by this means. The scheme is to be extended to the provinces, and Lille will probably be the first town to adopt it.—*Industries.*

The "Sting" Monitor Bell.

The new and very attractive bell illustrated on this page is one of a series recently brought out by the New Haven Clock Company. The cut is full size; a larger size is made when called for. Both bells are furnished with the hand top shown in the cut without any extra expense. Dust cannot get into any part of the bell, and the cap and bell gong can be removed without disturbing the wires or magnets and without removing the bell from where it is fastened. The bell is a model in its line.

Dunder's Telephone.

"Sergeant, maype you know somepody who likes to buy me oudt?" said Mr. Dunder, as he entered the Central station yesterday with a down-trodden appearance.

"Oh! it's you, is it?" queried Sergeant Bendall as he looked up. "Got into some fresh trouble, I suppose?"

"Sergeant, I vhas broke all oop. If I can sell oudt I doan shtay here two weeks."

"What's the occasion?"

"Vhell, it makes me feel better if I tell you. You know I keep a telephone in my place; I keep him to shpeak mit my brewer und to some aldermans. Yesterday a man who vhas as shlick ash grease comes in und says vhas I Carl Dunder? I vhas. All right. Mr. Dunder, der wires vhas crossed und your telephone doan' work. Sorry if you vhas troubled, but I feex him right off. Vhell, he goes mit dot phone und taps on der box, and takes down der trumpet und says:

"Hello, Central! Hello! hello! hello! Y—e—s! I vhas at Carl Dunder's. Can you hear me now? Why, of course, if he likes to treat me dot vhas all right. Nice oldt mans, und doan' you forget him. Vhell—all right—goot pye."

"Now, sergeant, I haf to ask him to take a glass of beer, doan' I? If I doan' I vhas no shentleman, eh?"

"Go on."

"Vhell, aboudt two hours later a second man came. He vhas shlick, too. Vhas I Carl Dunder? I vhas. All right Mr. Dunder, dot induction vhas so strong we vhas in a peck of troubles. Let me see how your telephone vhas. Und he goes oop und knocks on der box und softly says:

"'Hello! Bill, vhas dot you? No Yes. Perhaps. Vhy, I vhas down to Carl Dunder's place. I second de motion. I can get two hoonered votes for him for alderman. Hasn't treated me yet, but he probably will. Vhell, so long.'

"Now, sergeant, I hef to set oop der beer, doan' I? I feels tickled, you know, und I want to be a gentlemans."

"I understand. What else?"

"Vhell, some more fellers come, und I doan' suspect nopody until Shake comes home. Den he says it vhas an old shestnut, und dot I vhas soft in der headt. Dot makes me madt all oafer. Pooty queek somepody comes in. Vhas I Carl Dunder? I vhas. All right. Say, Mr. Dunder, when you ring on der telephone your number doan' drop in der office. Please allow me. Undt he goes oop and rings and calls oudt:

"'Vhas dot you, Nellie? Ah! dere, Nellie! Does dot number drop down when I ring? Say, vhas you going oop to der Flats next Soonday? Guess vhere I was? Not much! You vhas vhay off. I vhas down to Carl ——'

"Vhell, sergeant, dot vhas all I could shtand. I shump on der feller und gif him six weeks' sickness."

"Good! I honor your pluck!"

"Sergeant, keep quiet. He doan' go avhay oaver half an hour vhen my telephone rings. Vhas I Carl Dunder? I vhas. Dis vhas Superintendent Shackson of der telephone. Mr. Dunder, you haf almost killed one of our regular repairers, und I like to say to you dot it cost you more ash four honderd dollars!"

"No!"

"Dot vhas so. I doan' shleep two winks last night, und my wife says it vhill all come out dot I vhas McGarigle"

"It was a bad mistake."

"Vhell, vhas can I do? Shust like I tells you, nopody vhas two times alike. I vhas all der time shaking mit my boots, und Shake vhas going into consumption. Sergeant, if somepody arrests me let him be very soft und quiet. I vhas so broke oop dot I can't stand some more grief. If you see Mister Shackson tell him how it vhas. Tell him dot I vhas all turned around in dis country, und dot eafery time I kick at some dead beats he proves to be a shentlemans. Good pye, sergeant!"—*Detroit Free Press.*

Lighting Railroad Cars by Electricity.

We present a view herewith of Mr. S. H. Barrett's system of lighting railroad cars.

The dynamo and engine is placed in the baggage car. Steam is supplied from the engine. An eight horse power Colt disk engine, with a Tremont Electric Light Company 60-light dynamo, is used. A steam hose, coupled through to the engine, provides the necessary steam connection.

This, with incandescent lamps, fifteen to a car, forms an effective and complete lighting plant, with one exception. As long as the engine is attached, the system will work; it matters not whether the train is stopped or in motion. The dynamo, being run by an independent engine, will always generate current. But if the locomotive is uncoupled, then the dynamo engine, being deprived of its steam, must come to a stop. If it were necessary to detach one or more of the cars supplied by it, the cars so uncoupled could receive no more electricity from the dynamo, and would be left in darkness. To provide against these contingencies, each car is provided with its own storage battery. Of this, twenty cells are placed in a box under the floor of each car. They are stored or charged from the same dynamo that lights the cars.

Just under the centrifugal governor of the engine an automatic switch is arranged. By the action of this mechanism the batteries are thrown into or out of the dynamo circuit, as required. When they run down, and the current weakens, the switch closes, and they receive a charging current. As soon as charged, the switch opens and cuts them out, leaving them in condition for service whenever called upon. Normally, the greater part of the charging would be done in the daytime, so that the action of the dynamo at night, when the cars have to be lighted, need not be greatly complicated by the production of a charging current.

Switches to be operated by hand are also present in the system. By them the car lights can be turned from dynamo to battery, or the reverse. Thus the contingency of a breaking down of the dynamo is effectually provided for.

The effect of a car thus lighted is very fine. In place of the unsatisfactory oil lamps a quantity of brilliant incandescent lamps illuminate every corner of the car, so that it is as easy to read by night as by day. The light in its satisfactory qualities compares with gas. The element of safety is also of importance. The danger of fire is the greatest dread attaching to a collision or upset of a train. This danger is greatly increased by kerosene lamps, and it is far from certain that a high pressure gas reservoir may not be an element of risk in a disaster of this class. The electric light would seem the safest of all. The danger of the production of an arc is certainly quite remote. The first action of a collision would be to break some of the electric light leads and cut off the current entirely. It would be very exceptional for the conditions for an incendiary arc to be brought about. At the same time this is among the possibilities.

The electric light leads are connected between the cars by an extremely simple arrangement. Two half cylinders, whose faces form the contact plates, are held together in a spiral spring socket. This secures them so that no shaking can detach them; while a direct pull, as by the cars uncoupling, will draw them apart without injury. For the steam coupling a species of union or face joint is employed, held together by a screw and yoke. The joint is a metal-to-metal one, packing being dispensed with. It is so well made that the faces can be turned or twisted upon each other while the steam pressure is on without an escape. A self-acting plate or valve drops over and above the opening when the line is uncoupled, to exclude sand and dirt. This coupling is of the simplest description, and does away with one of the difficulties of the problem.

George W. Silcox, President and General Manager of the Korting Gas Engine Company, of New York, has recently returned from a two months' European trip.

Telephone Voices.

We have a new telephone girl on our circuit. We are all glad of it. The company has not advised us of any change, but we know perfectly well that the voice that we hear now is not the one that we heard last week.

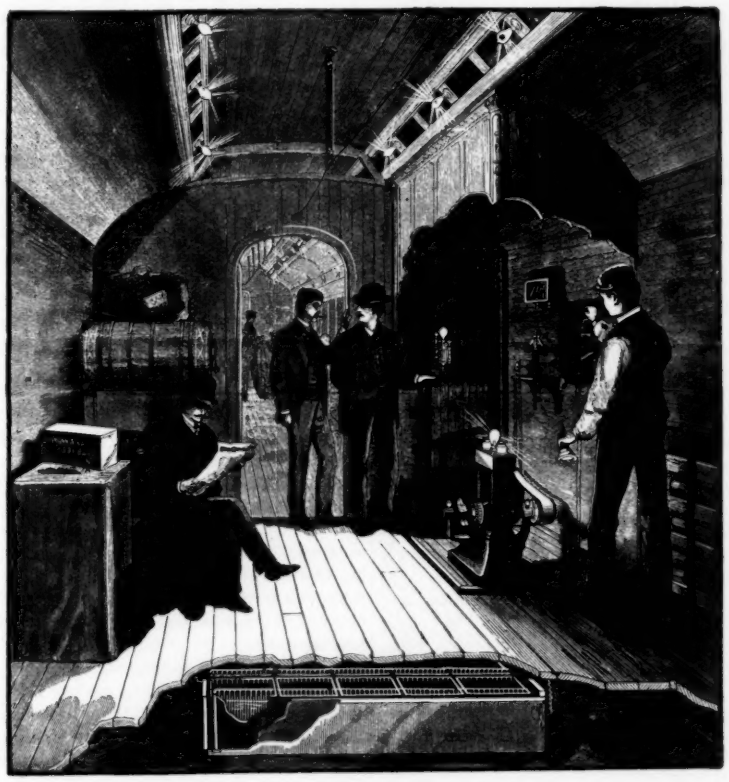
We take down the telephone with a new pleasure. Formerly it was no pleasure to use it; for we did not like to hear the weary, petulant, impatient voice that came to our ear. The position of a telephone clerk we know is a trying one. To sit still all day, connecting people's mouths with other people's ears, and to hear the stream of verbiage poured over the unresisting wires, the mixture of sense and nonsense, the incessant bell-ringing, the electric flies which seem to buzz on the wire, and the ceaseless clatter of scores of tongues, cannot be conducive to quietude of nerves. We, therefore, have all charity for the telephone girl of last week. Perhaps we may never hear her voice again. We should like to call her up once more, and say "good-by;" but, on the whole, we are glad that she is not going to remain on the line. It is such a delight, such a refreshment, when we call now, to hear a sweet voice come back, with a pleasing inflection and a refined gentleness of tone. There is nothing perfunctory about it. It does not ring just as the telephone bell does, because it has to. You do not think that the girl is working on a salary. When she answers, it seems as if you had a personal friend at the other end of the line, delighted to do you a favor.

No musical symbols have been invented which can express the quality and sweetness of a human voice. There is no way, therefore, that we can convey to our readers, in any symbolism of brush or pen, an idea of this voice. It is not a combination of bobolink and lark or nightingale; it is a thoroughly human voice and one thoroughly feminine. We know nothing of the speaker. The telephone company has not sent us a photograph. We did not hear her name, her antecedents, the color of her hair or her eyes, her age or how she dresses. These are all irrelevant in telephonic communication. She may be ugly beyond redemption, may dress in poor taste, and money-wise is in all probability anything but a rich heiress. But of one thing we are certain—her voice has soul in it; it is the music of a sweet temper and a good heart.

Marvelous tales are told of the amount of information which Agassiz could derive from a single bone. May there not be an undiscovered science of comparative vocalogy? We should feel perfectly safe in deducing certain conclusions from the new voice at the telephone. There is something more there than lung and larynx. It is a voice wreathed in smiles; it means a placid, expressive countenance. It is not the stridulous screech of a scold, nor is it the mandate of authority. It is simply the voice of sweet compliance. There is an element of sacrifice in it. It is the voice of one disciplined by experience, who has learned that there are other things to live for besides self; there is in it generosity, patience and self-control.

Without knowing it, our telephone clerk has revealed to us, simply through the tones of her voice, a chapter of moral biography. It is not in the words she uses; for she never says anything but "Hello," "All ready," in connection with the numbers which, with democratic impartiality, the telephone companies use to designate the identity of their patrons No, it is not words, but tone, inflection, quality, that reveal so much. That girl could say over the multiplication table and turn it into a psalm.

There is a good deal of significance in the Hebrew expression, "The voice of Jehovah," which is so often represented as speaking to the people, as if there were a revealing power in the human voice; and we are very glad of the revelation which the telephone company has made to us. We are sorry for the peevish, fretful tone that has gone. We shall be spared its wearisome "Oh, dears." We are as sorry for her as for those who will have to listen to her, but we welcome the new voice that sings over the line. There is something in it that was never learned of an elocutionist. It is the expression of a helpful, genial nature, that is determined to fulfill the duties of life, however vexatious they may be, with courtesy, patience and unfailing sweetness.



S. H. Barrett's System of Lighting Railway Cars.

Welding by Electricity.

The process of welding invented by Mr. De Benardoz, of Russia, is now applied industrially by the Society for the Electrical Working of Metals. The pieces to be welded are placed upon a cast iron plate supported by an insulated table and connected with the negative pole of a source of electricity. The positive pole communicates with an electric carbon inserted in an insulating handle. On drawing the point of the carbon along the edges of the metal to be welded, the operator closes the circuit. He has then merely to raise the point slightly to produce a voltaic arc whose high temperature melts the two pieces of metal and causes them to unite. The intensity of the current naturally varies with the work to be done. For regulating it, a battery of accumulators is used, and the number of the latter is increased or diminished as need be. This process of welding is largely employed in the manufacture of metallic tanks and reservoirs.

TELEGRAPHIC

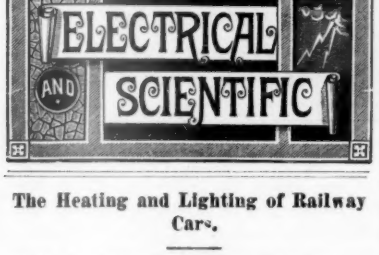
.... The Buffalo (N. Y.) Electrical Society has elected the following officers for the ensuing year: President, George H. Usher; vice president, Samuel Stewart; secretary, Madison Buell; treasurer, A. C. Terry; librarian, John M Stambach; executive committee, Messrs. F. Kitton, William Finn, and George Burnett.

.... O. W. Stager, who has been for many years superintendent of the Philadelphia, Reading and Pottsville Telegraph Company, headquarters at Reading, Pa., has been promoted to assistant superintendent main line division Transportation Department, Philadelphia and Reading Railroad, with headquarters at Broad and Callowhill streets, Philadelphia The skill and ability that he has shown in the telegraph department no doubt will lead to his promotion in the new field. He has been connected with the Philadelphia and Reading Railroad since the sixties, first as a telegraph messenger until, step by step, he reached the position of superintendent of their telegraph. Mr. E. R. Adams, who was his assistant, will succeed him as superintendent of telegraph.

The Telegraph in England.

The following is a summary of some of the statements made by Mr. Raikes, the Postmaster-General, in his speech delivered at the telegraph jubilee the other day:

At first a machine required five wires before it could dispatch a message. Now on one single wire seven or eight messages can be sent simultaneously. At first the rate of sending did not amount to more than four or five words a minute. Now on the latest machine no less than 462 words a minute can be dispatched. The number of messages has increased by steady steps, until now, under the new tariff and with the facilities that have been so widely extended since the telegraphs came into the hands of the Government, the number is truly portentous. Those sent during the past year amounted to close upon a million a week—51,500,000 in all. To put the matter concisely, the relative proportions between letters and telegrams have altered in the most astonishing way during the past thirty years. In 1855, when the public had become well used to the telegraph, and when every railway line was provided with telegraphic communication, for every telegram sent there were 439 letters. In ten years the proportion had risen to one telegram for every 151 letters. In 1875, the telegraphs having meanwhile been purchased by the Government, the proportion had risen again—it stood at one telegram for every fifty-six letters, and in 1886 it stood at one telegram for every forty letters. Of course, too, this increase has been more than a merely proportional increase. Letters have grown from 80,000,000 in the year of the Queen's accession to more than 1,400,000,000, and the absolute increase in the number of telegrams can be judged by that single fact. Moreover, if this is the testimony that can be brought to show the popular success of the telegraphs, more striking still is the story of invention, energy, disappointment, and final triumph, which is presented by the submarine cables. From the time when Mr. Crampton, in 1851, first overcame the difficulties of this branch of the work, down to the present time, when, according to Mr. Pender, there are some 115,000 miles of cables lying at the bottom of the sea, the progress in this department has been constant. As the romantic history of the first and second Atlantic cables showed, immense difficulties had to be encountered and grievous disappointments to be expected; but now, so great is the improvement in the method of making the cables, the chance of success is very large. The latest scheme, as the new Colonial blue books show, is for laying a cable under the Pacific Ocean, from Vancouver to New Zealand. Surely there is no task from which modern science will recoil.



The Heating and Lighting of Railway Cars.

By Paul Goepel, Before the German-American Technical Society.

Owing to a number of railway accidents which occurred in different sections of the country and in which cars were burned and a number of lives lost by the upsetting of the heating stoves in the cars, a law has been passed by the Legislature of the State of New York by which, from a certain date, the use of stoves for heating cars, and the use of kerosene lamps for lighting the same, is absolutely prohibited. The accidents referred to and the laws made in consequence thereof, have placed the problem of heating and lighting cars prominently before the public, and have drawn general attention to the means by which the law can be complied with and a greater degree of safety consistent with comfort, be granted to the passengers on our railways.

In examining the question of heating and lighting railway cars, it will be necessary, first, to consider the systems of heating and lighting heretofore in use, and secondly, to consider the means proposed by which the objections to the present systems can be obviated, and a safer and better method be substituted.

As regards the heating of railway cars, which forms the first subject-matter to be considered, we find that three different systems have been used for accomplishing this object; first, common heating stoves; secondly, heating stoves in connection with a system of hot-water pipes, or hot-air flues, by which the heat is conveyed from the stove to different parts of the cars, and thirdly, steam or hot air supplied by the locomotive, or from an independent steam generator for supplying all the cars of a train.

The first class of heating devices, the common car stoves, is open to numerous objections. They are not only highly dangerous in case of accident, but also objectionable because they do not supply a uniform temperature to the cars, supplying too much heat in their immediate neighborhood and too little to the farther parts of the cars. They have, therefore, been abandoned to a considerable extent, and better and more perfect systems introduced in their place. The one which has been most widely introduced, is the so-called Baker Hot Water System. This consists of a heater in one corner of the car, in the fire-place of which is arranged a coiled pipe without joints, which passes through the stove and is connected to an expansion drum on the top of the car. From the drum a pipe runs downward to the bottom of the car and then along the side of the same and under each seat, to the opposite end of the car, then along the other side of the car and under each seat of that side back to the coil, forming thus a continuous system of heat-radiating pipes, in which hot water circulates, which is prevented from freezing by being saturated with salt. The expansion drum above the roof of the car is made large enough to serve both as a reservoir for the brine and as an air-reservoir, the lower half being filled with brine, forming an enlarged part of the heating system of pipes, while the upper half is filled with air that escapes from the heated water. The air confined in the upper part of the drum acts as a cushion or elastic body which is compressed as the water below it is expanded by heat, and which thus allows the compressed circulation to go on continuously. The drum is protected against the weather by an exterior jacket that is attached to the roof of the car. The heating of the brine in the coil at the inside of the stove causes the same to rise and pass in the drum, from which it is distributed to the entire system of radiating pipes on the floor space under the seats, the cooled-off brine being returned by the pressure exerted on the same to the coil in the stove, so that a continuous circulation is thus kept up, and thereby a uniform temperature established in the car, which is regulated by suitable devices according to the temperature of the atmosphere. This system of hot water heating requires little attention and has been most extensively adopted by American railway companies.

In place of hot water, as in the Baker system, hot air has been used, which is supplied by flues connecting the heater with the different parts of the car, the fresh air being taken in from the outside by a ventilator on the roof of the car, heated in its passage through the heater and then distributed by flues and registers at both sides of the cars. The heaters of this class are known after their manufacturers, as Spear, Winslow, Johnson, Gouge, and other systems. Of these the Gouge system, supplied by the Gouge Heating and Ventilating Company, has been developed in the most effective manner. It takes in the air from the roof by a hood which is provided with a swinging valve so that the air enters when the car moves in either direction. The air passes down through a flue to the bottom of the furnace, and is then brought in contact with the entire heating surface by a series of ascending and descending flues until it is finally conducted through two flues, one of which extends along one side of the car, while the other passes transversely under the car body to the other side and then longitudinally along the opposite side of the car. The heated air is discharged through openings at the opposite ends of the flues, so that a nearly uniform temperature is established at both ends of the car. When the car is at rest the air blast, which is forced in through the hood and the flues, ceases, and the air is drawn in at the lower part of the heater in the usual manner, heated by the same and emitted through openings at the upper part for distribution. The objection to this system of hot air distribution is that the supply of hot air is interrupted whenever the car is stopped, and that during the stops the heater acts merely in the nature of a stove instead of keeping up a uniform supply of hot air. The advantages, on the other hand, are that the cars are evenly warmed, and that by the supply of fresh air the car is effectively ventilated at the same time. Other systems have been proposed for heating cars, either by air heated by exhaust steam from the locomotive by means of heating drums on the locomotive or below the bottom of the cars, the air thus heated being forced into the cars by a blower or pump. By this system a uniform quantity of heated air is supplied, whether the cars are running or stopping; but it has not received any extended application. Still another system provides an independent heater in the baggage-car, through which the air is forced by a pump or other air-forcing apparatus and conveyed by flues under the cars and through registers below the seats into the cars, the flues of the cars being connected by flexible couplings. This system also has the advantage of supplying a continuous current of air, and has the additional advantage that it can be used in summer for cooling the cars by supplying cold air, which is cooled by forcing it through coils located in an ice water-tank, and conducting it through flues at the top of the cars and distributing devices to the same.

The greatest efforts, however, have been made to supply the cars with heat by dispensing entirely with the heaters in the cars and using the steam of the locomotive for the purpose of heating the cars. Different systems have been proposed for utilizing the steam of the locomotive and heat the cars in a uniform and effective manner, amongst which are the Martin Anti-Fire Car Heater, the Safety Car Heater and the Gold Heater. The Martin Anti-Fire Car Heater takes dry live steam from the dome of the locomotive, reduces the pressure of the steam by a reducing valve, and then conveys the steam by a carefully wrapped main-pipe, that runs longitudinally beneath each car to the different cars of the train. The main-pipes are connected by universal couplings, which adjust themselves to every motion of the train. From the main-pipe the steam is supplied to a system of radiating pipes that is arranged along each side of the car and provided with a spur below each seat, by which the proper diffusion of the heat throughout each car is made. The water of condensation is collected at the lowest point of the system of radiating pipes at each side of the car and conveyed off either by a trap, or when the same is not desired to be discharged, to suitable collecting tanks carried below the platforms of the cars, which tanks are discharged at suitable points from time to time. This system has been introduced on a number of Western roads and has given considerable satisfaction. The Safety Car-Heating and Lighting Company, of New York, has a compromise system. It proposes to heat the car by steam from the locomotive but in addition thereto to utilize the present systems of hot water or hot air pipes that are used on the cars of so many railway companies, in connection with the Baker and other heaters. In this case, a heating drum is arranged below the car near the truck, and the steam from the locomotive supplied thereto by a covered main-pipe, connected by suitable couplings. In the drum is arranged a coil of pipe that is connected to the system of hot water circulation already in the cars in connection with the Baker heater. A steam-trap is connected to the heating drum for carrying off the water of condensation. This system has the advantage of heating the cars by hot water in the same manner as the Baker system, but that the water is heated by steam taken from the locomotive and has the additional advantage that whenever for some reason or other the train breaks down and the supply of steam from the locomotive is interrupted, hot water can be used by starting a fire in the heater and thereby the passengers protected in cold weather. The Safety Car-Heating System can also be used in cars heated by any one of the systems of hot air circulation, only with this difference, that the heating drum is made larger and connected by flues with the hot air distributing channels in the cars. When this system is applied directly to the cars the hot water circulating pipes are directly connected to the heating drums.

Another system, and one of the most ingenious devised for heating cars, is that of Edward E. Gold, of New York. This consists essentially of a combination of hot water heating and direct steam heating, the steam being obtained from the locomotive. It consists of iron cylinders arranged longitudinally along the sides of the car and partly filled with brine to provide for expansion. These cylinders are hermetically sealed, so that the brine in the same is retained at a constant strength and prevented from freezing. The brine cylinder is enclosed by a wrought-iron cylinder of some what larger diameter, which rests on supports at the bottom of the car, in such a manner that an annular space, wider at the bottom and gradually narrowing at the top, is formed between the brine cylinder and the outer cylinder. The enclosing cylinder is somewhat longer than the brine cylinder, and provided with end caps so adjusted as to leave a sufficient space for the longitudinal expansion of the brine cylinder. In the lower part of the caps of the exterior cylinder are openings, to which the steam pipes are screwed, so that the steam can pass freely in either direction through the outer cylinder and leave at the opposite end, together with the water which is condensed during its passage. The steam heats the brine cylinder by contact therewith, and at the same time heats the car by direct radiation at its outer surface. It has the advantage that a larger heating surface is obtained and that steam can be supplied in a short space of time, during which the locomotive stops at the different stations, or when the same is on down grades, for as soon as steam is supplied the outer cylinder instantly radiates heat into the car, while at the same time the brine cylinder absorbs heat and stores it up for future use. This is continued until the steam is shut off. The heat stored in the brine cylinder is afterwards radiated from the same and given off by the outer cylinder, maintaining thereby a uniform temperature in the car for a considerable length of time. The steam pipes of the cars are connected by suitable couplings and the water of condensation drawn off by traps of suitable construction. The ventilation of the cars is provided by vertical channels at each side of the car, which open to the inside of the car at their lower parts and to the outside at their upper ends. U-shaped heating pipes are arranged in these channels, which produce a circulation of air in upward direction, which, in connection with the ventilation through the windows and dome of the car, is sufficient to properly ventilate the cars. This system has the advantage of securing the quick heating of the cars when the same are made up into a train, that it takes away no seating capacity, as is the case with heaters, and that the use of steam is considerably less than in other systems, as the extra pressure of steam which is let out at the stations or on going down grades is utilized for heating up the brine cylinders and storing up the heat in the same for future use during the intervals of time when no steam is supplied.

THE LIGHTING OF CARS.

American railway cars are lighted by three different systems: by kerosene lamps, by gas, and by incandescent electric lamps. The system of lighting cars with gas has not made much headway, and the system of lighting cars by electricity is still in its experimental stage. It seems that the great variety of well constructed and ornamental lamps, which are supplied for the lighting of cars, have to some extent prevented the introduction of the system of lighting by oil gas which is so extensively introduced in the cars of European railways. The liberal manner in which American cars are lighted by a number of oil chandeliers is almost unknown in Europe. Railway lamps are manufactured in all kinds of styles and prices by a number of firms, especially by Post & Co., in Cincinnati, who make a great variety of lamps for all the different purposes required by railroad companies. The system of lighting cars by compressed gas has also many advantages as to convenience and safety. It is known as the Pinch system, and is supplied by the Pinch Lighting Company, of New York, which has succeeded in introducing it in the cars of the Erie, West Shore and other roads. It consists of oil or naphtha gas, which has the property of being capable of compressing without losing any of its illuminating power, while coal gas if compressed loses nearly 50 per cent. of its illuminating power. The gas is generated in suitable gas works, stored in a gas holder and compressed by pumps in storage cylinders, at a pressure of 150 to 180 pounds to the square inch. From the storage cylinders the gas is conducted by subterranean pipes to the filling valves which are located in convenient places in the railroad yard or passenger sheds. Each car is equipped with cylindrical gas reservoirs which are supported below the bottom of the car and which are filled with gas in from three to five minutes, by connecting the reservoir by a strong rubber hose with one of the filling valves. Each car has two gas reservoirs, 8 feet by 6 inches long and 20 inches in diameter, which, when filled to ten atmospheres' pressure, have capacity sufficient to supply for from thirty to forty hours, according to the number and size of the burners. A pressure-reducing valve or regulator is introduced between the reservoirs and the burners, so as to supply the gas at a uniform pressure to the burners under the varying pressure of the gas in the reservoirs. All the lamps can be controlled by a cock for regulating all the flames in the car at once, so that all the lamps can be lighted in entering a tunnel, or be turned down by a single movement. The supply pipe passes over the roof of the car to the different lamps, which are suspended from the roof, supplying a steady and even flame in all conditions. The supply of air to the flames is heated in its passage to the burners

by the escaping products of combustion, so as to produce not only a more perfect combustion, but also a clear and white flame. A glass globe encloses the lower part of each lamp, and a porcelain reflector throws the light downward, and distributes it through the car. The Pinch system supplies a light which is free from the dangers connected with kerosene lamps. It has met with great success in Europe, and it is believed that only the cheapness of kerosene, and the good quality of the lamps used, has prevented its more extensive introduction in this country. As regards safety, it is far superior to the kerosene lamps, and has so far not given any cause for complaint on this score, as, in case of accidents, the gas, being under pressure, escapes quickly, and can do but little harm, even in case of its being ignited.

Recently attempts have been made on the New York and Boston trains to light cars by electricity. For this purpose a number of storage batteries are used, which are supplied by the Julien Electric Company, of New York. The storage batteries are carried in a receptacle at the bottom of the car, and the lamps in the same connected with the batteries. Suitable switches are provided for turning on or off all or part of the lamps. The batteries are charged at terminal stations by a dynamo. A double set of batteries is used for each car, five being used for each car, each set containing six batteries. Twenty-four lamps are arranged in two rows in the car, and the car lighted almost as bright as day. This system is to be introduced on other through trains, especially on the New York and Chicago Express. It seems to have given satisfaction to the roads on which it has been used for some time. The expense is said to be about .06 cents a lamp per hour, which is not too expensive.

There is another system of lighting cars by electricity, which, however, has not yet been introduced in this country, and which may be briefly mentioned. This is the system invented by Loebbecke and Oestreich, and improved by the Electro-Technische Fabrik Cannstadt, in Cannstadt, Germany. In this system a dynamo is arranged in the baggage car, and driven by connection with the axle of the car, always in the same direction, and in such a manner that the current of the dynamo is regulated, either by mechanical means, or by electrical means, said dynamo serving to charge alternately one of two storage batteries, which are arranged below the bottom of each car, and connected with the glow lamps in the same. While one storage battery supplies the current to the lamps, the other is charged by the dynamo, whereby a steady light is obtained independently of the speed of the train, and without requiring the charging of batteries and a charging plant at certain stations. This system has been tested on the Wurtemburg State Railroads, and has given considerable satisfaction. This system has given good results, though, perhaps, for greater simplicity, the system of the Julien Company may be preferred. At present the lighting of cars by electricity is still in its experimental stage, and it requires some time yet before its practical adaptability is demonstrated.

CONCLUSION.

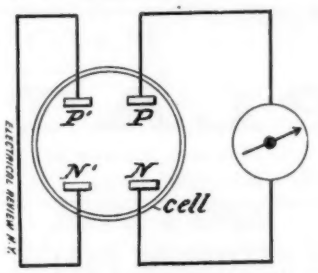
Reviewing the different systems of car heating and lighting described, with a view to determine which is best adapted to the requirements of the law, which prohibits the use of stoves and oil lamps in the car, it seems that for all those cars which are at present equipped with heating stoves and hot water pipes or hot air flues connected thereto, the system proposed by the Safety Car Heating and Lighting Company, of New York, is best adapted, as it utilizes the pipe and flues in the cars and uses steam heat supplied by the locomotive for heating the water or air, while permitting the use of the heaters in case of emergency. As regards economy of steam and the quick and effective diffusion of the same, the system of Edward E. Gold, which permits the storing up of the heat for later use, so as to be used when no steam is available, possesses great advantages, especially as by this system the cars can also be conveniently warmed before making up the train, by supplying steam from other sources than the locomotive, whereby some of the objections made to the heating by steam from the locomotive are overcome. None of the systems proposed are yet perfect, but by experience, the objections can be overcome, and gradually such a degree of safety be obtained that present dangers of railroad travel are greatly diminished, and that by improved systems of heating, lighting and ventilating railway cars, the health of the passengers be not impaired and the comfort in traveling greatly enhanced.

Singular Action of Two Galvanic Couples in One Cell.

To the Editor of Electrical Review.

I present below the results of an experiment which I believe to be new, and which may be of assistance to those who are endeavoring to discover the seat of the electromotive force in the galvanic cell.

If the positive and negatives electrodes, *P* and *N*, are connected with a galvanometer in circuit, and a second pair of electrodes, *P'* and *N'*, are placed near them, it will be found that when *P* and *N'* are connected by a short wire, a permanent deflection of the galvanometer occurs, indicative of a decrease of current, although the external circuits have no connection with each other. If the positions of the electrodes *P'* and *N'* be reversed, then the galvanometer indicates an increase of current when they are connected. The effects are gradually lessened as *P'* and *N'* are removed from *P* and *N*.



Transposing *N'* and *N* or *P'* and *P*, so that the hypothetical paths of the currents in the electrolyte traverse each other, does not influence the action.

The elements I used were zinc and carbon, and the electrolyte a solution of sal-ammoniac; the galvanometer was sensitive enough to be strongly deflected to its stop by a single couple, and the needle was brought to zero, after the circuit was closed, by a bar magnet placed near it. By properly placing the magnet the needle will respond to slight variations in the strength of the current.

WM B. COOPER.

Philadelphia, Aug. 30th, 1887.

A Scoundrel's Ingenious Attempt to Use Electricity for Revenge.

There recently occurred in Brooklyn, so states the *Eagle*, an electrical incident that was in every way remarkable. Shortly before 9 o'clock P. M. the regulator which governs the current of electricity generated by one of the forty-five light machines in the De Kalb avenue station of the Citizens' Electric Illuminating Company rose and cut off the current till only sufficient electricity for two lights was generated. Something was wrong, and an inspector and several linemen went out to see what was the matter. They searched for two hours and a half, and at length located the seat of trouble among the tree branches at the top of a pole in front of the jail in Raymond street. They found that the submarine Mackay-Bennett cable and the electric light cable were connected by two fine copper office wires. The insulation had been peeled off both cables at two points, and the fine copper office wire attached to the bare copper cables. One of the fine wires ran from the telegraphic cable to the electric light cable in such a way as to carry the news that came under the sea to the unappreciative electric lamps, and the other was intended to take the full force of the electric current and send it over the Mackay-Bennett cable.

The work was evidently that of a man who knew precisely what he was doing, and had figured the results out to a nicety. The submarine cable, after crossing the bridge and going to its office in Wall street, New York, connects with the main line of the B. and O. Telegraph Company, and the effect of its carrying the full force of a forty-five light electrical machine would be to destroy the switchboards in the main offices of New York and Philadelphia and the little Brooklyn office, and to render every instrument useless just when there was a great rush of special press cablegrams for the Sunday papers. The operators would have received a slight shock, but no more. That is what the gentleman who connected the cables planned, and if he had been successful he would have destroyed about $10,000 worth of property in the cities named. As it was, he did no damage at all except to delay the press matter in question, and to astonish the New York operators of the Baltimore and Ohio office with the force and incoherency of the messages they were getting from the electric light station, and to extinguish all lights on the circuit beginning at Raymond street, except one or two between the station and the point where the cables were connected.

The ingenious scoundrel was evidently not aware of the qualities of the Thomson-Houston regulator, which is a little machine used under the Thomson-Houston system to meet such emergencies. As it was, the regulator, finding that not so much current was needed for two as for forty-five lights, immediately accommodated itself to the circumstances.

President Charles Cooper, of the Citizens' Company, said, after he had explained how the attempt had been made:

"I notified the Baltimore and Ohio people, and they have been searching for the man who put up the job. If they find him they will give him an interesting time, you may be sure of that. I don't think they will find him, though. Most probably he is some lineman, and linemen are a roving tribe. They move quickly from city to city, and there are several thousand of them in New York and Brooklyn. They don't stay long with a company, and they are great for getting square. The man who put up this job was probably a discharged lineman. He may be away in Canada or Omaha by this time, wondering what hindered him from burning out all the Baltimore and Ohio's switchboards. When I say burning out, I don't mean that actual fire would be generated and that buildings would beset on fire. There would be no visible fire at all, just a slight crackling along the wires, yet all the delicate instruments of the company would be ruined. There was no danger to life."

Prof. Forbes on Primary Batteries.

Our bright London namesake says that, as regards primary batteries, "the cry is, still they come!' Never, we think, have there been such times for batteries. After the 'Eclipse,' which has eclipsed everything in pure British "cheek," comes the Schanschieff Electric Battery Company, registered with a capital of £25,000. For the benefit of intending investors in primary battery shares we give a little anecdote which is rather *apropos* at present. Last year at the Dynamicables an evening was set apart for a discussion of the merits and demerits of primary batteries. Amongst others the Upward battery was brought prominently forward, and Prof. George Forbes was called upon to speak. It was evident that the Professor had been considering the question, for he had sat grave and moody during the discussion, apparently buried in the deepest abstraction. But being called upon, after a preliminary cough, he spoke, his speech being to the effect that notwithstanding all that had been written and spoken of primary batteries, if he were to light up his house he should use nothing but Grove's cells. They were a great nusiance and made an awful mess, but he had yet to learn that batteries subsequently invented were less of a nuisance or less messy ! ! ! Prospectuses please copy."

Another Carbon Works.

The Thomson-Houston parent company have been quietly at work for a few weeks past erecting a complete plant for the manufacture of arc-light carbons, and are now putting the finishing touches to it. The new works are located at Fremont, Ohio, and are fitted throughout for the use of natural gas as the exclusive fuel, of which they have an unlimited supply for the heaviest needs. The output will begin probably in about thirty days at 50,000 per day, which will be increased, as the new machinery gets well going, up to the demands of their market; the capacity being intended to reach up to 200,000 per day. The appointments are of the highest grade, the machinery of the latest and best design, and the Thomson-Houston Carbon Company, under the vigorous handling of Mr. W. R. Caulkins, its general manager, is in a fair way to add another to the list of successes already scored by the parent company. We wish them success.

—— A contract has been let by the Braddock Wire Works, Braddock, Pa., for the erection of a new mill that will change the methods at these works. Heretofore the rods made at the mill have been sent to St. Louis to be drawn. The company have decided to do this at Braddock, and the new mill will be used for that purpose.

ELECTRIC LIGHT NEWS

—— The Globe Electric Light and Power Company has been awarded the contract for lighting the town of Red Wing, Minn

—— The Meriden (Conn.) Gas Company and Meriden Electric Light Company have consolidated with a capital of $250,000, and George R. Curtis, of the gas company, was chosen president.

—— The Austin Water Light and Power Company, of Austin, Texas, have just ordered one 13x12 and two 10x12 engines from the Ball Engine Company, of Erie, Pa., to run their electric light station at Austin, Texas.

—— The Clinton Gas Light Company have just bought the electric light plant, complete, per 90 arc light, Schuyler system. This plant was owned by Treasurer Bigelow, Goss & Forbes, who bought it last January of the Schuyler company.

—— At Halifax, N. S., J. W. Chandler & Co. have nearly completed negotiations with the city by which the former will erect in ninety days an electric lighting plant. It is said eleven firms are trying to secure the contract from Chandler & Co. to build and equip the station and plant.

—— The Philadelphia agent of the American Electric Manufacturing Company has closed a contract with the Wissahickon Electric Light Company to fit their station with the American system. He also contracted with J. Gerson, 40 and 42 N. 8th street, for a 15 light machine; both plants to be installed at once.

—— The Marr Construction Company have recently put in operation an Edison station at La Crosse, Wis., employing two 150 horse power automatic engines of the Taylor Manufacturing Company's make, which, together with the entire plant, are giving excellent satisfaction. The local company already have 2,500 lights in use, which are steadily on the increase; and the incorporators are much pleased with the prospects for their enterprise.

—— Mr. C. A. Breck, proprietor of the Electro-Light Engraving Company, of this city, has instructed Mr. Charles L. Levey to fit up his works with a complete installation for instantly copying pictures. Mr. Levey proposes to equip the gallery with actual 2,000 candle power focusing lamps, and has ordered from the American Electric Manufacturing Company a specially wound dynamo for this purpose, with the required focusing lamps; the whole to be operated so as to produce a daylight effect by concentrating the light to a given point, if so desired, which will result in a more rapid means of photographing, irrespective of the condition of the weather.

—— The annual sheep-bake of the Business Men's Association of New Haven, Conn., was celebrated in the enjoyable and unique manner peculiar to a Connecticut sheep-bake last Saturday. Of course President Gilbert, of the Boston Electric Light Company, was present—and every sheep in the vicinity became faint with terror on hearing of his arrival—as were several other electric men, among them Col. Hooker, of New Haven, and H.D. Stanley, of Bridgeport, both of whom deserve special mention for the unsurpassing mutton-devouring qualities displayed. The bake was baked at Compounce Pond, a special train carrying the party of seventy. Good music, plenty of tender lamb, corn and sweet potatoes, and an inexhaustible supply of clear spring water supplied every want, and with Hon. N. D. Sperry as toastmaster, the barbecue was a feast, not only of eatables, but in addition all were privileged to listen to a number of brilliant and inspiring toast responses. The bake was a pronounced success, and undoubtedly lingered in the dreams of many of the attendants for one, and possibly two, nights afterwards.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING SEPT. 6, 1887.

369,320 Underground electric cable; John H. Dalzell, Pittsburgh, Pa.
369,349 Electric lamp; Osborn P. Loomis, Somerville, Mass.
369,372 Lead-armored conductor and process of making the same; Thomas G. Turner, New York, N. Y.
369,376 Telephone; 369,377, Krotophone; 369,378, Krotophone receiver; 369,379, Telephone transmitter; Frank C. Watkins, Philadelphia, Pa., assignor, by mesne assignments, to the United States Krotophone Company, New York, N. Y.
369,386 Electric synchronizing attachment for clocks; Edmund F. Bard, New York, N. Y.
369,394 Electrical conductor; Henry F. Campbell, Concord, N. H., assignor to the Campbell Electric Company, of New Hampshire.
369,400 Dynamo-electric generator; Rudolf Eickemeyer, Yonkers, N. Y.
369,432 Electrical heating apparatus; Albert H. Buckelew, New Brunswick, assignor to himself and Charles H. Buckelew, Plainfield, N. J.
369,435 Art of splicing cables; John Collins, Oakland, assignor of one-half to Squire V. Mooney, San Francisco, Cal.
369,436 Lightning arrester; Augustus B. Depuy, Camden, N. J.
369,439, 369,441, 369,442, 369,443 System of electrical distribution; Thomas A. Edison, Llewellyn Park, N. J.
369,447 Insulator; Edwin T. Greenfield, New York, N. Y., assignor to Greenfield & Co., same place.
369,456 Electric arc lamp; Hermann Lemp, Hartford, Conn., assignor to the Schuyler Electric Manufacturing Company, of Connecticut.
369,505 Galvanic cell; Luis Drescher, New York, N. Y.
369,561 Apparatus for lighting cars by electricity; Sidney H. Short, Denver, Col., assignor to the United States Electric Company, same place.
369,593 Bunched electric cable; 369,594, Manufacture of diminishing electric cables; John H. Dalzell, Pittsburgh, Pa.
369,595 Magnetic register connection for water meters; Albert S. Dietzman and George Cressey, Louisville, Ky., said Cressey assignor to Henry R. Mitchell, same place.
369,608 Voting and recording apparatus for legislative bodies; Barton S. Molyneux, Minneapolis, Minn., assignor of one-half to Alfred Humphreys, same place.
369,640 Arc lamp; David J. Hauss, Cincinnati, Ohio, assignor to the Hauss Electric Manufacturing Company, same place.
369,664 Carbonizing mould for incandescent electric light filaments; 369,665, Method of testing electric light filaments; 369,666, Carbonizing mould for incandescent electric light filaments; Edward P. Thompson, Elizabeth, N. J.

PATENTS.

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"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court [7 Beekman St.,] New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed, to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend." —*New York Observer*.

BUSINESS NOTICE.

ELECTRIC LIGHT.—Wanted, half a dozen good men to work on arc lamps and electrical instruments; men with families preferred.
THE MATHER ELECTRIC CO.,
Manchester, Conn.

NOTICE.

The Incorporated Village of SALEM, O., wishes propositions from Electric Light Companies to establish and operate an Electric Light Plant on Rental System.

Proposals to be in by September 23d, 1887, at 12 o'clock, noon.

For particulars, address

A. H. HARRIS, Chairman or Com., Salem, Ohio.

Otto Gas Engine Agency,

NEW YORK,

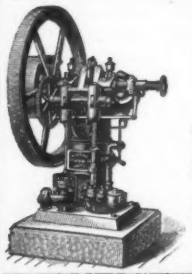
A. C. Manning & Co.,

47 DEY STREET,

REMOVES ON MAY 1ST,

—TO—

18 Vesey Street.



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GAS ENGINE
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Most economical Engine yet offered to the public, and specially adapted for running dynamos.

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WE GLADLY TESTIFY to the SUPERIORITY of the
MUNSON
Eagle and Dynamo Electric Light Belt.

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TESTIMONIALS.

Western Edison Light Co., H. WARD LEONARD, General Sup't.
W. J. Buckley, Mgr. Ft. Wayne Jenny El. Light Co.
Thomson-Houston Electric Light, Herbert Wadsworth, Manager Western Office.
Brush Electric Co., Alex. Kempt, Special Agent.
Excelsior Electric Co., C. J. Reilly, Western Mgr.
Sperry Electric Light Motor & Car Brake Co., 201 Royal Insurance Building.
J. H. Reid, General Manager of the Mather Electric Light Co., Chicago.
Wm. H. Purdey, Comm. of Public Works, Chicago.
John Mab, Chief Engin'r of Board of Trade, Chic.
C. J. Melmes, Gen'l Sup't Thomson-Houston Light, Omaha, Neb.
J. A. Corbey, St. Joe Electric Light and Power Co., St. Joe, Mo.
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Our Leclanche Faradic Medical Battery is of a new and entirely original design.

It is a new departure, and avoids the use of all obnoxious acids that destroy the clothes, stain the hands and make the constant handling of such medical batteries absolutely dangerous.

It is simplicity itself, and in ordinary use will run ONE YEAR WITHOUT ANY ATTENTION, OR THE EXPENDITURE OF A SINGLE PENNY FOR SUPPLIES.

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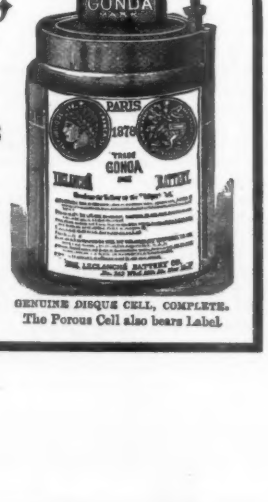

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